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ARTHUR H. HOWELL

(1872 to 1940)

BY VIOLA S. SCHANTZ

Arthur H. Howell, Chairman of the Editorial Board of the American Society of Mammalogists, was stricken with a cerebral hemorrhage at his desk on July 9, 1940, while engaged in mammal studies. He passed away at Emergency Hospital, Washington, D. C., on July 10.

Mr. Howell was born in Lake Grove, N. Y., on May 3, 1872, the son of Elbert Richard and Ann (Judson Holmes) Howell. He graduated from the Brooklyn High School in February 1888, and then spent the greater part of that year at Lake Grove, Long Island, N. Y., living and working with his grandfather, Richard Oakley Howell. Together they operated both his grandfather's and his father's farms.

In January 1889 he obtained an office position at $3.00 a week with a small ship broker on South Street, New York. He remained there only a few weeks, then went to work for several months with an insurance broker. On November 18, 1889, he was hired by Jenning's Lace Works, New York City, as a stock clerk at $6.00 a week, and remained with that firm in various capacities until July 1894.

During the winter of 1894–95, for a period of five months, Mr. Howell was employed as business secretary by the Brooklyn Men's Christian Association.

His interest in natural history—birds in particular—had begun in 1885, soon after he entered high school and became acquainted with Joseph A. Hopkins. Hunting birds' nests and collecting birds' eggs was their principal diversion on Saturdays and holidays.

Mr. Howell's first set of eggs (crested flycatcher) was taken in June 1885, but his collecting did not begin in earnest until May 1886, when he went to

his grandfather's farm on Long Island for the summer. In the spring of 1888 he began to mount birds but never became proficient in that art.

Mr. Howell made his first study skin on December 15, 1888, and the next spring he began to make a collection. In January 1889 he became acquainted with William Dutcher, and on the latter's invitation began to attend the meetings of the Linnaean Society of New York, where he made the acquaintance of many local naturalists. On March 2, 1892, he was elected secretary of the Society—an office he held for two years and then declined a re-election. During his incumbency he put in a great deal of time arranging and cataloguing the pamphlets in the Society's library.

In 1889 Mr. Howell became a member of the American Ornithologists' Union. He met Harry C. Oberholser at the annual meeting held in New York City that year. The two became better acquainted in 1894 when Mr. Oberholser lived in Brooklyn, N. Y., for a period of 9 months. During that time Mr. Oberholser took a civil-service examination for a position in the Department of Agriculture and received his appointment in the Division of Economic Ornithology and Mammalogy at Washington, D. C., on February 1, 1895. This Division became the Bureau of Biological Survey on March 3, 1905.

In the spring of 1895, Vernon Bailey, of the Division of Economic Ornithology and Mammalogy, needed a field assistant, and Mr. Oberholser suggested the name of his Brooklyn friend, Arthur H. Howell. In May 1895, Mr. Howell received a temporary appointment and was sent on a field trip to northwestern Montana as an assistant to Vernon Bailey. They camped together in Montana, Idaho, Washington, and Oregon for four months, after which Mr. Howell traveled alone in Idaho, Utah, and Colorado, returning home via Washington, D. C., in November of that year.

In May 1896 Mr. Howell received a second appointment of six months at Washington, D. C., in the Division of Biological Survey, as it became known on April 25, 1896. At the end of the six months he received a permanent appointment as a special assistant, his work for the first few years being the preparation of scientific study skins and care of the mammal collection.

Mr. Howell became one of America's outstanding mammalogists and ornithologists, and his keen interest kept him actively engaged in research, even though he was eligible for voluntary retirement in May of this year from his position as senior biologist in the Division of Wildlife Research, Fish and Wildlife Service, Department of the Interior, which Service superseded the Biological Survey on June 30, 1940. His Federal service began with the Division of Economic Ornithology and Mammalogy in 1895, and he served the Government continuously for 44 years. During this period he published 80 papers and books on birds and mammals. Among his outstanding con-

tributions to the science of mammalogy were his descriptions of 83 species and subspecies of mammals, and his revisions of the scientific classification of many genera published in eight numbers of the famous North American Fauna series of the U. S. Department of Agriculture. These revisions include two genera of skunks, the harvest mice, marmots, flying squirrels, pikas, chipmunks, and the ground squirrels. "A Revision of the American Arctic Hares" was published in 1936 in the Journal of Mammalogy (vol. 17, pp. 315–337). At the time of his death Mr. Howell was preparing two other manuscripts for the North American Fauna series: "A Revision of the Classification of Red Squirrels" and "The Mammals of Florida."

He conducted biological field expeditions in Alabama, Arkansas, Florida, Georgia, Illinois, Kentucky, Louisiana, Missouri, Montana, New Mexico, and Texas. These field trips led to the publication of "The Birds of Arkansas," "Birds of Alabama," and "Florida Bird Life," the last his most outstanding contribution to ornithology.

In 1919 he discovered and described a new species of bird, a seaside sparrow, *Thryospiza mirabilis*, in southern Florida. This was an enviable achievement at a time when North American birds had become so well known. Among his other important works on birds were studies of "The Relation of Birds to the Cotton Boll Weevil," "Birds That Eat the Cotton Boll Weevil," and "Destruction of the Cotton Boll Weevil by Birds in Winter."

Mr. Howell was a self-made naturalist, and his reputation for achievement in his special field was international. Having worked in the same laboratory with him for many years, the writer always found him to be a man of sterling character, thoughtful of others, and always willing to share his scientific knowledge with a junior associate.

Mr. Howell was a charter member of the American Society of Mammalogists, and had been chairman of the Society's editorial committee since January 1938. He had served as a member on the Society's Board of Directors since 1935. He was also a Fellow of the American Ornithologists' Union since 1930; a member of the Baird Ornithological Club, Cooper Ornithological Club, and the Biological Society of Washington; a corresponding member of the Linnaean Society of New York; and a member of the Rhode Island Avenue and Suburban Citizen's Association. He had been interested in choral work and was an organizer of the Biological Survey Group of Friends of the National Symphony Orchestra. He was also a member of the First Congregational Church in Washington, of which he was an ardent supporter.

While living in Brooklyn, N. Y., Mr. Howell was active in the work of the Central Congregational Church, where he taught a Sunday school class for a number of years. Later he took up the work of the Young Peoples Society and was one of the prime movers in organizing a Christian Endeavor Society in the church, serving as its first president for two years.

On June 20, 1900, he married Grace Bowen Johnson, of Washington, D. C. Surviving him are his widow and three children, Ruth Alden (Mrs. E. E. Stansbury), Elizabeth Carolyn, and Elbert Jerome. For many years Mr. Howell resided at 2919 South Dakota Avenue, Washington, D. C.

Funeral services were held in the Washington First Congregational Church at 3 p.m. on July 11. Many Federal officials, associates, and friends attended. Interment took place at Fort Lincoln Cemetery, Washington, D. C.

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THE BURROWING AND FEEDING HABITS OF DIPODOMYS VENUSTUS

By Albert C. Hawbecker

Late in the fall of 1937, while trapping gophers in newly-planted fertilizer and cover crop test plots, I found indications of kangaroo rat activity on two farms in southern Santa Cruz County, California. In an effort to learn more about the animal, as well as to learn something of its effects on agricultural lands and crops, I began a more intensive study of its habits in November, 1937.

Subsequent trapping, and later identification by Dr. E. Raymond Hall of the University of California revealed that the specimens from the Enos farm were the Santa Cruz kangaroo rat (*Dipodomys venustus venustus* Merriam), and those from the Berglund farm represented a possible intergradation with the elephant-eared kangaroo rat (*Dipodomys elephantinus* Grinnell), but needed further study to determine their exact status.

The main field of investigation was the J. F. Enos farm just north of the small settlement of Corralitos in southern Santa Cruz County, California. This farm lies 700 feet above sea level in the Upper Sonoran Life Zone, according to indicators set down by Hall and Grinnell (1919). The soil type is Moro Cojo sand, well drained and deep, warm and dry in summer (soil type names according to U. S. Bureau of Plant Industry standards). This farm was originally covered with such plants as chamise (*Adenostoma fasciculatum*), black sage (*Salvia mellifera*), manzanita (*Arctostaphylos tomentosa*), buck brush (*Ceanothus cuneatus*) and coyote brush (*Baccharis pilularis*), all of which are characteristic of the native flora found on Moro Cojo sand. The farm was entirely cleared at one time, but erosion rapidly rendered the steeper slopes unproductive and they were eventually allowed to return to the original cover. Additional observations were made on the Karl Berglund farm which is situated about two miles above the Enos farm by the old Rider Road, in a more mountainous and more heavily wooded type of country. The portion of the Berglund farm known as the old Rider ranch, where the

study was carried on, lies at 1450 feet and has Hugo loam and sandy loam, which are also well drained, as its main soil types. The original cover here was, and the persisting adjacent cover is typical of the Transition Life Zone. It is made up of coast redwood (*Sequoia sempervirens*), Douglas fir (*Pseudotsuga taxifolia*), madrone (*Arbutus menziesii*), tan oak (*Lithocarpus densiflorus*)

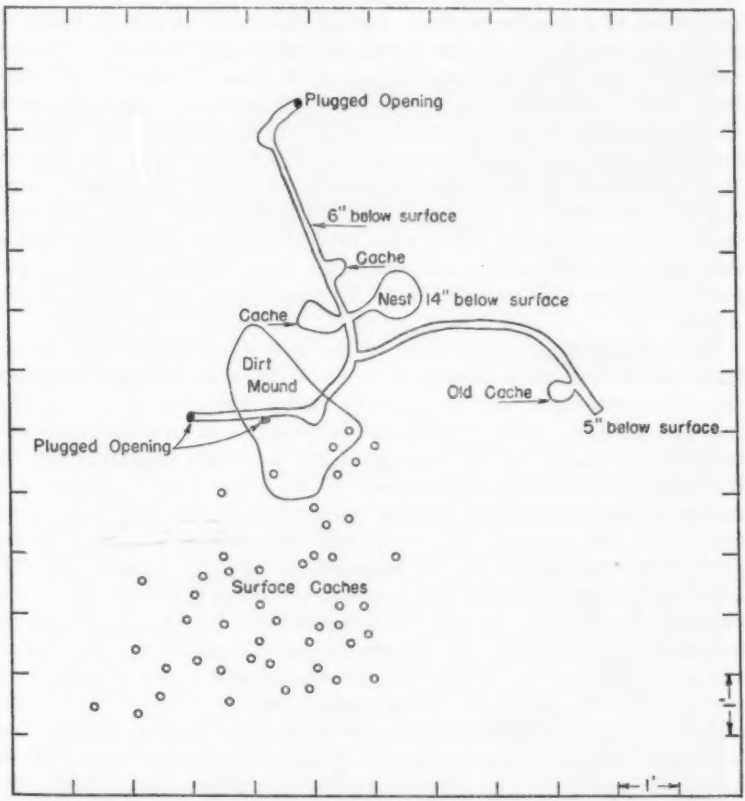

Figure 1. Sketch of a typical den of a Santa Cruz Kangaroo Rat.

and coyote brush (*Baccharis pilularis*), the last named being found along the field borders adjacent to the woodland. Volunteer annual vegetation on both of the farms is about the same. Rip-gut grass (*Bromus rigidus*), sheep sorrel (*Rumex acetosella*), and telegraph weed (*Heterotheca grandiflora*) are the mian constituents. The first two mature late in the spring or early in summer and the last one in the fall. Lack of summer rain allows most of the herbaceous

vegetation to dry, so there is only this dry, brown material and what stored food is left over for kangaroo rat food during the summer and fall. The climate is mild with summer fogs and often heavy winter rains. Additional observations were carried on whenever the animals were found, but the above areas constituted the main points of study.

The first step in the study (November 9, 1937, to March, 1940) was the excavation of a number of dens. Fifteen dens were excavated during the study, some carefully and some merely to find caches and nests. The dens were not found in the chaparral, but out in the open, abandoned agricultural land. There probably were burrows in the chaparral as traps set along the edge, and slightly in the chaparral usually caught kangaroo rats. It seems also that the animals must travel through and live in the chaparral as the Berglund farm is surrounded by either redwood or dense chaparral. As was expected, the kangaroo rat dens were found in the well-drained soils such as those mentioned above. They were never found in heavy soils. Not all such areas are inhabited by kangaroo rats. Many similar farms were gone over and no sign of the animals found. There are apparently other controlling factors.

The most striking characteristic of the dens is their relative simplicity. Such burrow systems as illustrated by Shaw (1934) for the giant kangaroo rat (*Dipodomys ingens*) and described by Bailey (1931) for some of the New Mexican kangaroo rats, are veritable labyrinths compared with the ones made by this animal. A single main runway, a few blind side branches and the usual nest and food caches constitute the entire burrow system. One measured burrow was 8 feet long with a 4-foot 6-inch side branch, five caches and a nest. Burrows known to be at least two years old did not show any greater degree of complexity than those known to be only months old. The lack of protection offered by such a simple main burrow system seems to be partially offset by the fact that each animal apparently has several supplementary burrows not too closely associated with the main one. The presence and use of such burrows was first discovered when, while excavating a burrow system, I saw an animal break out through one of the side branches that ended near the surface and make directly for another opening. Excavations in other dens often gave rise to the same performance; when the animal left the main burrow there was no indiscriminate rushing about, but a direct flight to a new haven of safety. Often, but not always, one or both of the usually two main burrow openings, as well as one or both of the auxiliary burrow openings, were under weeds or shrubs. Excavation in the supplementary burrows revealed that they were simple, often unbranched runways without nests, caches or sidepockets. They were left open at all times. In fact, the point of distinction from the surface of the ground between main and subsidiary burrow systems was that the main burrow openings were almost invariably plugged and the subsidiary burrow openings were always open.

FIG. 2. Upper: The main study area

FIG. 3. Lower: The sprouted caches are shown here. There are a few single ones in the foreground and background, but they are concentrated in the center. December 5, 1938.

The exact use of these burrows is a subject for further study. Supplementary burrows were also found by Vorhies and Taylor (1922) in their study of the banner-tailed kangaroo rat (*Dipodomys spectabilis spectabilis*); but in that case they appeared a little more closely connected to the main system.

The general structure of the main burrows or dens is much like the dens of other kangaroo rats as described by previous investigators, except for its simplicity. It also tends to be more of the sprawling type described by Shaw (1934) than the compact type of Vorhies and Taylor (1922). The burrows that I excavated lay from 2 to 20 inches below the ground surface except where as sometimes happened the kangaroo rats were occupying gopher burrows. During the rainy period they were damp as the rain soaked into the ground to a depth of 5 feet. This condition differed from that found by Grinnell (1932) in the burrows of the giant kangaroo rat where a portion of the system was always dry. These dens in addition to their rightful owners, were often inhabited by such insects as crickets and dung beetles, and by toads. Occasionally two kangaroo rats were taken at the mouth of the same burrow, but there was no other evidence that two animals use the same system.

As Shaw (1934) suggests in the case of the giant kangaroo rat, it is certain that the habits of *Dipodomys venustus* are affected by agricultural practices. The areas that I studied lay adjacent to orchards that were subject to normal cultural operations, and while gophers and even ground squirrels were able to burrow at will under these conditions, the kangaroo rat burrows were conspicuously absent. Even light harrowing was sufficient to break up housekeeping for the kangaroo rat as was often evidenced when the farmer happened to run his harrow across portions of the uncultivated field. In all cases the relatively shallow burrows were completely destroyed. On the other hand, in places where cultivation ceased for a year a kangaroo rat population moved in and dug burrows.

The test plots showed no damage as far as erosion and crop injury were concerned even though there were many kangaroo rat dens. The lack of gullying was possibly due to the shallowness of the dens and the porosity of the lighter soils, in which they were excavated. It was found, however, that where permanent contour ditches or any type of earth structure whose surface is not cultivated were constructed through or in cultivated land, kangaroo rats soon invaded them and extended their workings along the berms far out into the orchard. Such workings soon honeycomb the ditch or structure, and weaken it to such an extent that it gives way, often causing a serious break. The remedy for this is to disk lightly over the ditch in the course of farm cultivation late in the spring after the seed has ripened. This caves in most of the rodent burrows and drives out the kangaroo rats, but does not destroy the protective vegetation on the ditch berms.

The study of the food and storing habits of this kangaroo rat revealed

several interesting features when compared with Shaw's (1934) findings on the giant kangaroo rat. The food of the local species like the ones studied by Shaw (1934) and by Monson and Kessler (1940) is made up almost entirely of seeds of annuals as far as can be determined by cheek pouch, underground cache and surface cache examinations. Among the test plots were two, one of crested wheat grass and one of English rye grass, both perennials; but neither one was utilized as far as could be determined. One burrow opened into one of these plots, but there was no sign of mowing nor were any of the seeds found stored either in surface or underground caches. Traps baited with rolled oats were occupied or sprung and the bait gone even when green material was available. A captive animal kept for five months took any commercial seed (oats, rye, barley or vetch) in preference to green material such as cabbage, lettuce, grass or root vegetables. This same animal did not use water put into the cage, but lived for months without using either water or green food material. Some green material is used, however, as a burrow excavated in May, 1939, had a number of green heads of sheep sorrel strewn along it. Animals trapped for specimens in March, 1940, had green bur clover (*Medicago hispida*) in their cheek pouches. Except for a little debris, however, no material has been found in any of the caches except mature seed or seed husks.

The favorite food is the achene of the native telegraph weed. This seed, with the pappus attached, was stored in great quantities, one or two underground caches, containing up to 3145 c.c. of material being found in each burrow, packed full of the small, light seed on December 2, 1938. Considering the fact that the seed was not collected from the plant but must have been picked up from the ground, one can see that an enormous amount of labor was consumed in gathering these very small seeds. The plant is the commonest on the Enos and Berglund ranches, which is probably the reason it is the one utilized. The next species of plant most utilized is rip-gut grass, found almost as commonly as telegraph weed. It seemed that this plant might be more commonly utilized than telegraph weed as the seeds are larger and more easily gathered, but such was not the case. This seed was harvested after it became ripe and fell to the ground. Seeds of other native or introduced plants such as sheep sorrel, bur clover and poor man's weather glass (*Anagallis arvensis*) were found in pouches or caches so sparingly that their notation is of little consequence. Interestingly, common pepper grass (*Lepidium nitidum*) so important in the food list of the giant kangaroo rat (Shaw 1934 and Grinnell 1932) was not found in any of the caches of *Dipodomys venustus* although the plant is fairly common in and about the plots.

The most striking and most puzzling factor in the seed gathering and storing operations is the surface cache (well described by Shaw (1934) for the giant kangaroo rat). Structurally, the surface caches that I found were much the same as those described by Shaw, but were generally 4 inches

deep and about 2 inches in diameter. They were usually grouped more or less fan-wise about the mouth of the burrow, but were often found singly at some distance from any burrow. This suggests that the caching instinct may become developed to a point that may be termed "promiscuous." Surface caches were found about the mouths of most of the main burrows but were not found at the subsidiary burrows. Seed for some of these caches was carried as far as 168 feet from a known source (actual measurement).

Contrary to Shaw's (1934) findings, these caches were not used by *Dipodomys venustus* as a curing bin, except in one possible instance. On May 23, 1939, while preparing to excavate a den I found a number of shallow pits about one-half an inch deep that contained panicles of sheep sorrel covered lightly with sand. These were near a burrow that on excavation revealed the same plant strewn along the bottom. Careful observations made around other burrows at that time and since have failed to reveal a similar condition. All other surface caches have been deeper and contained mature ripened seeds. It is puzzling to know just what the use of the normal surface cache is. Close observation failed to show any transference from the surface cache to the underground cache. Seed in a ripened condition was garnered as it fell to the ground, not before, as no plants were found cut. It was then carried either into the burrow and stored or put into one of the surface caches. The material put into the surface caches was in a ripened condition because a soaking rain caused the cache contents to sprout, sufficient evidence that it was ripened and needed no curing.

The contents of these surface caches were largely the various commercial seeds that were planted in the plots on or about October 15 of each year. The possible reason for this will be discussed in the paragraph dealing with food preferences. As I have said, when the rains soaked the light soil, the surface caches began to sprout. Commercial seed was spread on the plots on November 3, 1937 and by November 19, after the rains had started, each burrow opening was partly surrounded by small, very compact, individual stands of rip-gut, rye, barley, oats and vetch, as well as various combinations of all species. No surface caches of telegraph weed were ever found. Clumps from these caches grew, matured and died, but as far as could be found, they were not utilized. Desultory excavations were made by the kangaroo rats and some cutting was done as the seedlings sprouted, but no real harvest was made nor were any of the sprouted seeds salvaged. Thus it is hard to explain these surface caches, the use of which is so necessary to the storing activities of the giant kangaroo rat, unless one concludes that the instinct of *Dipodomys venustus* leads it to store in excess of its needs. The plots were not planted in the fall of 1939 and there were few sprouted caches except a few of rip-gut grass after the rains began. Although kangaroo rats were not as abundant as before, they were present as was proved by trapping. Thus it appears that the underground caches were filled before the

plots were sown. When they found the newly sown seed the animals were not able to withstand the lure of the new windfall and stored in surface caches. Or else the familiar native seed was gathered in preference to the commercial seed until the former was gone. The Berglund farm area was sown to commercial seed for a cover crop, and that was the seed stored in the surface caches by the kangaroo rats.

The underground caches were much like those of other species, but were not as numerous nor as large. As the food in them is used, the caches are left full of husks and sand. Excavations made on June 1, 1939, showed this sand being removed but no storing yet started. Underground caches were always near enough the surface to allow rain to penetrate, often causing the seed in them to sprout. Caching of the seed is carried on during the summer and autumn when the seed begins to ripen and fall. It presumably ends when the seed becomes scarce.

As for food preferences, it is possible for one to conclude the seed of the telegraph weed is preferred to rip-gut grass since the latter matures first, but the former is always found in greater abundance in the underground caches. After the greater part of the telegraph weed is gone then probably the kangaroo rats turn to rip-gut to finish filling their caches. Finally after these caches are filled, they store available seed in surface caches rather than building additional underground caches. There was little commercial seed found in the underground caches because they were probably full before that seed was sown; or perhaps the animal continues to store the familiar native seed until it is nearly gone before turning to the commercial seed.

The effect of the rodent on the sprouting and mature commercial seed was rather slight. There was quite a bit of commercial seed gathering in October or November when the cover crop seed was spread on the test plots, but except in one case, a good stand was always obtained. In the one case, six plots failed because of poor seed. They were replanted on December 23 to rye. In a very short time the kangaroo rats had stripped all the plots of the rye seed. It is believed that there must have been enough of the familiar native seed left in October to keep the animals fairly well occupied, but by December the native seed must have been gone. Hence when the new supply became available the kangaroo rats concentrated on it. They probably used it for immediate food rather than for storing. No trace of it was found either in underground or surface caches. No damage was noted to the newly sprouted or older plants; the animals seeming to lose interest in the seed after it had sprouted. A small plot of oats some 100 feet by 50 feet was left outside of the plot fence between the plots and the native brush. At the end of the growing season the plot resembled an inclined plane with the oats nipped off lowest next to the brush and least bothered next to the fence where the greatest number of kangaroo rats were, according to trapping records. Observations indicate that local species of rabbits were responsible for this

cutting. Fallen mature seed from this plot was taken, however. Thus, it may be concluded that the Santa Cruz kangaroo rat is harmful to crops only at the time the seed is spread; and, if there is sufficient familiar seed present at that time, the commercial seed will not seriously suffer.

The nest cavity of this kangaroo rat was usually lower than the rest of the burrow and was filled with seed coats of the rip-gut and chaff from the telegraph weed. The nest often contained live insects such as crickets and dung beetles along with the kangaroo rat. A nest dug out on May 31, 1939, contained an adult and a single young, which was too small to run. It squirmed to get away and made a frightened, sucking noise.

Effects of its enemies on the animal have not yet been determined. Fifty-seven barn owl pellets picked up in a gravel pit near the Enos plots contained no bones of kangaroo rats. Coyotes are common, and wildcats, feral house cats, and owls are present. Why the *Dipodomys* was so much scarcer in 1939–40 than before is not known. Disease, predators, weather, or other factors may be responsible.

No conclusions as to the economic status of this rodent are being drawn. Certain things, however, such as its preference for annual seeds, its ready elimination by cultivation, and its rapid infestation of areas left uncultivated are obvious.

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BEAVER-TROUT RELATIONS

By David B. Cook

The relation of beaver to trout is an interesting and complex problem in ecology which has, considering the importance of the animals involved in it, received less than its fair share of attention. Many of the salient facts concerning the ecological requirements of both beaver and trout are known and some of the interrelationships between these facts are reasonably apparent.

The beaver is one of the most important forest mammals in the Northeast. In Colonial times it was a mainstay of the fur trade and its pelt was, on occasion, used as a medium of exchange. Today it is esteemed far more for its ecological values than for its intrinsic worth—what it can do while alive rather than what its hide is worth.

In the Northeast, trout afford sport to multitudes of anglers each year. Trout and beaver often occupy the same stream at the same time and their relations to one another are matters of concern to all who are interested in securing the greatest amount and variety of products from our wild lands.

The beaver is the only mammal, excepting man, capable of making any large-scale change in its environment to suit its own needs. While the changes that it makes are intended for its own benefit, they sometimes render a stream less suitable for trout or for the insects on which the trout feed.

Literature is replete with material about beaver. Morgan (1868) had an unexcelled opportunity to study them under essentially primitive conditions, for Michigan, at the time when he wrote, had been practically an empty country for forty years. More recently, Bradt (1938) has worked out the details of life history and social behavior.

Concerning the ecology of trout there is a wealth of material, both British and American. The best work on this subject is by Needham (1938). Some relations of beaver to trout have been reported by Salyer (1934).

I have enjoyed unusual opportunity to study beaver-trout interrelations. Two decades of general observation throughout New York State, mostly incidental to other work, have been supplemented by special study. Since the summer of 1933 observations have been made on a colony of beaver living on my forest near Stephentown, New York, as well as on a dozen other beaver colonies in adjacent parts of Rensselaer County. From 1935 through 1939 I had active charge of the stream development program in New York. This work afforded a wonderful opportunity to learn the ecological requirements of trout and the part that beaver can play in effecting their welfare. On several occasions I have been faced with the necessity of passing administrative judgment on specific cases of conflict. The opinions expressed herein are personal and do not necessarily reflect the opinion of the New York State Conservation Department.

Inasmuch as trout do not contribute to beaver economy in any way, the relation is a unilateral one. To anyone familiar with conditions in New York, it will be apparent that, because of the great diversity of flora, fauna, topography and land use, there can be no broad generalization and that each case must be judged on its individual merits. I shall endeavor to show how the various ecological factors may be effected and how important the effect may be.

For the Northeast, the essentials of life history and ecological requirements of brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo fario*) are reasonably well known. The breeding fish move upstream in late fall in search of sections where gravel bottoms and unfailing supplies of spring water are available. For brook trout, the water temperature must not fall below 37°F. or the eggs will perish. It is probable that the same is true of brown trout. The nest is dug in the gravel and the eggs deposited. The eggs do not hatch until spring. The young fish may remain in the nursery stream or may move down (at any age beyond sac-fry) to a neighboring pool or to bigger water. This downstream movement is not yet well understood.

Unlike mammals, fish have an indeterminate growth rate, so that there is no direct correlation between size and age. Brook trout may mature, reproduce and presumably die at 5 years plus without coming to legal size (7 inches), while fish of a pound weight may be only three years old. It is obvious that the larger fish will require bigger pools than will small ones and that the most rapid growth is made by those fish having access to the most abundant food supply. Extremely cold water slows down metabolism and growth rate. With 6-inch brook trout, the increase in food consumption between water temperatures of 40°F. and 60°F. is 280 percent (Deuel, 1937). High water temperatures, particularly those above 72°F. induce the fish to eat large quantities of food. But these high water temperatures reduce the amount of oxygen that the water can hold in solution. Hence, the fish, unable to get enough oxygen to digest their food, may die of stuffing.

Small trout feed on invertebrates, particularly the aquatic larvae of insects, while trout more than 12 inches long depend more heavily on small fish. Very pure, cold water does not produce much food and the fish living therein grow slowly. Maximum poundage production of trout may be expected in fertile and relatively warm streams.

To fully appreciate the effect of beaver on the trout habitat, let us consider their own life history and behavior. Bradt (1938) has pointed out that subadult beaver are evicted from the colony at the end of their second year, probably in April or May in our climate. They wander about in search of mates and new locations and, if successful, settle down to form new colonies. Each pair builds a dam or series of dams and may dig a burrow or build a lodge. These new dams are low, seldom flooding beyond the creek channel itself. Because of the small size of the dams and the limited food storage

required by only two beaver, the number of trees cut is small. The ponds are often so small that their limits are difficult to trace when the snow is deep. Young are born the following spring. Some work may be done on the dams, but tree-cutting is at a minimum, as the beaver feed on smaller plants, succulents and tubers. With the advent of fall, provision for two adults and the young must be made. But the supply of food is usually ample and close to the water, so the ponds remain small. In relation to trout, the essential unit is the pond, irrespective of how many beaver may live therein.

At the end of the second year the colony should have grown to its approximate maximum of two adults, two or three sub-adults and two to four young, about the population level that will remain stable. As the demands on the food supply increase and the nearer trees are used up, the ponds are often extended. In some cases, auxiliary ponds or canals are built. Ponds appear to be essential for food storage, and perhaps for protection; but their greatest usefulness is in affording easy access to the food supply. The labor of hauling green wood over dry ground is considerable, whereas, once afloat, wood is quickly and easily transported. Therefore, as long as there remains sufficient food—particularly trees for winter storage—the colony will persist. The chief limiting factor appears to be the food supply.

My colony still contains the original pair—presumably nine years old in the spring of 1940—three sub-adults and four kits. At times the animals have had to go far afield in their search for winter food. Their dams on the main stream have been burst three times in eight years. But they have always made the necessary repairs and their occupancy has been continuous. The sub-adults from my colony have scattered up and down stream to establish new ponds. The main colony has never had more than two acres of water at any one time and has secured its food from an area not exceeding ten acres. Some other colonies in the vicinity have made bigger ponds because of local peculiarities in topography.

Let us consider the effect that the beaver may have on trout ecology. The cutting or drowning of stream-side trees exposes the stream to the sun. Joined with this is the general warming effect of the broad, shallow ponds. These two factors may well raise the water temperature to the danger point of 72°F. The exact effect will depend on four major factors: the amount of fall in the stream, the width of the floodplain and the nearness and height of the adjoining upland, the number of ponds on the drainage, and the normal temperature range of the water. A dam on a stream with little fall and a well-developed floodplain will impound a long, wide, shallow pond whereas a similar dam on a fast, steep-banked stream will form a short, narrow and relatively deep pond. A single pond on a stream may have no appreciable warming effect, while the cumulative effect of a series of ponds may be disastrous to the trout. On warm streams, where the temperatures approach the limit of tolerance for trout, even a single pond may adversely effect the fish,

while cold streams with an abundance of spring feeders may actually be benefited by beaver ponds.

The oxygen content of the water and also the content of dissolved humic acid are subject to change by beaver. Where new ponds drown broad expanses of forest soils, particularly those under coniferous stands, where there is a deep accumulation of undecomposed litter, leaching may increase humic acid sharply and decrease oxygen dangerously. This condition continues when older ponds begin to fill up with peat. Even on a relatively clean bottom, oxygen conditions may be unfavorable in deep water. To compensate, there may be some aeration of the water in passing over the dams. Low oxygen content is most pronounced on small streams that lack sufficient flow to flush the ponds frequently.

Ponds act as settling basins in which the water deposits all or part of its burden of suspended silt as well as its bed load of sand and gravel. Inasmuch as the production of bottom insects is roughly proportional to the coarseness of the stream bottom, the deposition of silt and fine sand on rubble bottoms smothers out such important trout foods as mayflies (*Ephemerida*), stoneflies (*Plecoptera*) and caddice-flies (*Trichoptera*). On the other hand, the ponds increase the water area and the opportunity for the production of minnows and of the weedbeds that harbor diverse forms of fish food. Ultimately, beaver ponds go through the same filling process as do natural ponds. Then, the accumulation of silt, sand, and peat may again reduce the water area.

Beaver ponds certainly obstruct the free movement of fish. On sizable streams, flood stage offers enough water for fish to pass the dams both going up and coming down. But when the fish are moving up in the fall, there can be no assurance that there will be sufficient flow to permit passage of the dams. This condition is serious only when there are not enough fish above the dam to insure adequate spawning. The dams tend to separate the stream into sections with poor intercommunication, a condition that may occasionally cause undesirable local concentrations of fish.

Where dams are established on small streams, the permanent water area that they afford may be of great benefit in holding fish when the remainder of the stream becomes low or dry. As the ponds offer relatively rich feeding, the fish in them grow rapidly. The ponds are high-grade ecological niches that tend to fill up to capacity with fish. Angling is easier in them than in the stream, and, as the fish keep coming in from less favored sections, heavy fishing may be disastrously effective.

In winter, water temperatures may fall to 32°F. when the ponds freeze hard and the inflow is low. Such a temperature is lethal to trout eggs. The deposition of silt on the nests shuts down water circulation and may kill the eggs by smothering. Trout spawning in beaver ponds is not apt to be successful.

From this discussion it is apparent that the presence of beaver on a trout stream may be of considerable benefit or harm to trout, depending on the total effect of a number of divergent factors. On streams where the fall is so low that a small dam backs up a large, shallow pond, on those where considerable areas of coniferous forest floor are flooded, or on those where water temperatures are normally high, the beaver will be distinctly harmful. Where the ponds are small, the stream flow irregular and subject to drought or the temperatures low, beaver ponds will be of decided benefit to trout. Between these extremes lies a broad band where the merits and demerits are more closely balanced and where the only reasonable basis of determination is by a field examination of each individual case.

Many other values are involved in beaver ponds. The storage of water by a series of ponds may be considerable, both in the ponds themselves and in the additional ground water held in the soil because of the raised water table. The ponds are ideal breeding places for black ducks. Deer, muskrat, raccoon and otter may use them. Finally, the pelts of the beaver themselves are an item of no mean value. They probably represent the highest net return per acre of any use to which forest land can be put.

In view of these many values, it is imperative that the activities of the beaver be fairly judged and that the animals be condemned as harmful to trout only on valid evidence.

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ON THE PIKAS OF NORTH MANCHURIA

By A. S. Loukashkin

In North Manchuria three forms of pikas occur, namely, *Ochotona daurica*, *Ochotona hyperborea mantchurica* and *Ochotona hyperborea cinereo-fusca*. The first of these occupies the high steppes and semi-deserts of the Barga upland, the second the rocks and cliffs of forested mountains of the Great Khingan Range, and the last the mountainous country along the Amur River near Heiho (opposite Blagoveschensk).

The Dahurian pika makes its burrows in the flat places. Here the animals form colonial associations. Their burrows are not so deep as in the next species, and when one crosses on horseback the great stretches occupied by the colony of Dahurian pikas, his horse every now and then breaks through into the underground shelters of the animals.

At the end of August these animals prepare their hay stocks for the wintertime. They cut off the grass stems at the root and bring them to selected places on the open ground surface, piling the grass in small cone-like heaps, arranging it so that the tops are below and cut ends above.

Such a haycock after drying weighs from two to five pounds. When drying their grass the pikas turn their haycocks over several times until they become well prepared hay. Many hundreds and sometimes even thousands of such minute cones can be seen in September, covering an area of two to three square kilometers occupied by the colony.

The Dahurian pika does not show preference to any particular kind of plants; it feeds on any kinds that occur. Various species of *Artemisia* constitute a considerable percentage in their stocks.

Mongolian herders, knowing this peculiarity of the Dahurian pikas, utilize their hay stocks in winters, when hardened deep snow covers the steppe, and grazing for the cattle and sheep becomes very difficult. The Mongolians drive their herds to localities where there are pika colonies and the hungry animals feed upon the pika stocks.

The voice of this pika is quite pleasant and even muscial. It is a whistle broken at short intervals, beginning on a high note and descending to low ones. The sounds resemble the voice of a bird rather than that of mammal.

The pika is heard whistling mainly early in the morning just after daybreak, and after sunset. In springtime I have heard its voice more than once near Dalainor Lake at midnight. Therefore, I conclude that it is on the alert almost all day and all night.

The Dahurian pikas bring forth their young twice a year. They are very delicate in captivity, living a short time only.

The Siberian fitch (*Putorius eversmanni michnoi*) and the least weasel (*Mustela rixosa pygmaea*) appear to be their natural enemies.

The Manchurian pika (*Ochotona mantchurica*) keeps to the basalt rocks, making its dwelling in crevices and cavities of the cliffs, and in burrows under big stones lying on the surface.

The Manchurian pikas do not put their hay in the form of a conical heap. Instead of this they hide the hay in conveniently situated holes in trees and in the rotted out cavities of stumps, or sometimes under wind-felled tree trunks, and in cavities among rocks. Its hay stocks are piled in formless masses that may reach a weight of 15–40 pounds. All the hay stocks that I saw were located in safely hidden places. This precaution enables the pikas to save their food from the forest robbers, among which are the Ussurian moose (*Alces alces bedfordi*), Siberian roe-deer (*Capreolus capreolus pygargus*) and varying hare (*Lepus timidus transbaicalicus*).

The Manchurian pika is social in its habits, but its colonies are usually not so large as in the foregoing species. Only on the lava stream of the "Fourteen Volcanoes Country" (or Ujun Holdonger in the Dahur language) have I met with enormous colonies, where I had a splendid opportunity to observe pikas at almost every step. There they found unusually favorable conditions. Numberless crevices and rocks made it possible for them to hide at any danger.

These pikas make long paths, connecting one burrow entrance with another. The same paths are used also for their "expeditions" in order to collect grasses from the nearest meadow. In July they begin to collect and dry grasses. The food materials brought from the meadow they put on heated rocks in small packets or in the form of long rows. Immediately after it dries out the hay is removed to places of safety. Such work is continued every day during July and August.

The sound produced by the Manchurian pikas is a very loud, sharp, monotonous, and short whistling. They are exclusively diurnal animals in their habits, and very active. I have never heard their voices in the night. Both the Dahurian and Manchurian pikas are remarkable for their absolute cleanliness. Their lavatories are situated on the surface somewhat outside of the burrow entrances. Usually they execute their necessities of life somewhere near a stone or some other protruding object. The urine is very dark-rusty in color, and the excrements are dry and of ball-like form the size of a Singapor pepper, dark-green or blackish in color.

When eating herbs, Dahurian and Manchurian pikas do not hold them in their fore paws, like the rodents; but exactly like hares and rabbits, they stand on all four legs and work only with their jaws. They always begin to eat at the base of the stems, gradually following to the upper parts and leaves.

The Manchurian pika appears to be mainly an inhabitant of the forested mountains, where the Dahurian larch (*Larix dahurica*) is the predominating

tree. In such a forest the *Rhododendron dahuricum*, a heavy moss carpet and thickets of *Vaccinium vitis-idaea* compose the undergrowth.

While moving from hole to hole and in visiting grazing grounds the Manchurian pika makes use of tunnels and paths made through the moss carpet. It often climbs on the wind-fallen trees, stumps, and rocks, from which it suspiciously looks over the surroundings. After feeding it likes to rest on some elevation (rock, timber, etc.) and warm itself for hours in the sunshine.

In December a deep layer of snow covers the Great Khingan Range for the whole winter. At this time the pikas make very long trenches and tunnels under the snow; unwillingly and seldom do they appear on the snow surface.

The Manchurian pikas absolutely fail to survive captivity. They die in live-catching traps before the arrival of the collector, probably within an hour or two after the moment of trapping.

The main enemies of the Manchurian pika are the Siberian yellow mink (*Mustela sibirica*) and the yellow ermine (*Mustela alpina*), both of which freely penetrate into the pikas' burrows.

The larvae of *Hypoderma* sp. are parasitic in the body of the Manchurian pika. Usually a pair of larvae are located on the belt under the skin one on each side. In cases when there are more than four larvae in one animal the result is usually fatal.

Both Dahurian and Manchurian pikas are noted for their curiosity. When they see a man approaching they begin to whistle and then hide themselves. If at this time the observer stops and remains motionless they disappear into the burrows or crevices, but after a short time they appear again on the surface approaching closer and closer (following by the underground ways), until they finally arrive at a distance of only three or four meters from the observer. Then they remain hidden behind a rock or tree, or at the exit of their burrow, keeping close watch of the observer. After a short time the observer may be able to see several muzzles of pikas looking for him from their hidden shelters, and ready to disappear at any sign of danger. If the observer stays motionless and is sufficiently patient, the pikas come to the surface of the ground and continue their activities close to his feet.

Various kinds of mouselike rodents live in association with the pikas and make use of their paths, tunnels and burrows, especially in winter. I have trapped *Phaiomys brandti*, *Stenocranius gregalis raddei*, *Cricetulus furunculus*, *Phodopus songarus*, and even *Allactaga mongolica* in traps set at the entrance of the burrows of *Ochotona daurica*. The same association was observed when I was collecting *Ochotona mantchurica* on the Great Khingan Range. Very often I had good luck there with small mammals about whose presence in that region I had no knowledge. For instance, in 1935 (November–December) I brought back to Harbin a good series of *Clethrionomys rutilus*

hintoni, *Phaiomys vinogradovi*, *Apodemus major rufulus*, and *Apodemus agrarius mantchuricus*, all of them having been trapped on the paths of colonies of *Ochotona mantchurica*.

As to the third form of pika, namely *Ochotona hyperborea cinereofusca*, I can say nothing because I have never had a chance to observe this animal under natural conditions.

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A POPULATION STUDY OF THE LONG-EARED CHIPMUNK (EUTAMIAS QUADRIMACULATUS) IN THE CENTRAL SIERRA NEVADA

By Robert Holdenried

It seems strange that such a colorful and interesting mammal as the chipmunk should not have stimulated people to study it more intensively. Published observations are scattered and brief, and population studies, particularly of numbers and movements of individuals, have scarcely been touched, although recent papers by Allen (1938) and Cahalane (1939) suggest a trend in this direction. The lack of published material provided the stimulus for this paper.

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Between August 1 and November 16, 1939, a trapping program was undertaken to study the composition of rodent populations, with particular reference to numbers, seasonal activity and movements. Food habits and other activities not revealed by trapping alone were recorded also. This program was carried on for the Hooper Foundation of the University of California in an investigation of rodents concerned with the spread of sylvatic plague.

Description of habitat.—The area on which this study was made is on the southwest slope of Graham Mountain, three miles north of The Pines, Bass Lake, Madera County, California. It is at an elevation of 4500 feet in the Sierra Nevada. The mountains here are rugged and covered with trees or chaparral, with scattered small openings. In summer the temperature often rises above 90 degrees F. in the shade, with a range on some days as great as 40 degrees. The area was logged in 1927, and old logs and tangles of dead limbs are still present over most of it. The tangles provide homes for large numbers of chipmunks.

Incense cedar (*Libocedrus decurrens*) and white fir (*Abies concolor*) are the most numerous trees, with yellow and sugar pines (*Pinus ponderosa* and *P. lambertiana*) nearly as abundant. The black oak (*Quercus kelloggii*) is the only deciduous tree growing in appreciable numbers. Gooseberry (*Ribes roezlii*) covers most of the area not heavily shaded by trees, while deer brush (*Ceanothus integerrimus*) is even more generally distributed.

Methods.—Intensive trapping was carried on over approximately 30 acres. A grid system was used with traps in lines 180 feet apart; in each line the traps were placed every 90 feet. A line with traps similarly spaced encircled the grid. There were 89 traps in the grid and 106 in the encircling line. The area was divided into four sections; after one section had been trapped continuously for one week, operations were discontinued there for the following three weeks, while the other sections were each trapped in turn. This system of rotation allowed a larger area to be studied and avoided too much disturbance of the chipmunks' normal activity.

TABLE 1.—*Summary by months of the trapping activity and of the number of long-eared chipmunks captured*

MONTH	NO. OF TRAPPING DAYS	TOTAL NO. OF TRAP UNITS	NO. OF ANIMALS TAKEN	NO. OF TRAP UNITS PER ANIMAL	NO. OF TRAP UNITS PER CAPTURE
August	12	1093	49	22.3	11
September	15	804	59	13.6	5.3
October	20	1169	56	20.9	6
November	13	726	20	36.3	10.4
Total	60	3792			

Animals were marked by amputation of not more than one toe from each foot. The various combinations of toe removal make it possible to mark 899 animals in this way. Marked animals can be quickly and easily recorded by the use of symbols. For example, an animal from which the third toe on its right foot has been removed is recorded as FR3, F representing "front foot," R "right side" and 3 the toe that was amputated. Similarly H represents "hind foot" and L "left side." Toe-clipping methods have been in use for some time, but this modification of the system described by Ashbrook (1936) allows a large number of animals to be marked with a minimum of injury to any individual involved.

Other than *Eutamias quadrimaculatus* mammals of the following ten species were captured: *Sorex* sp., *Citellus beecheyi*, *Eutamias quadrivittatus*, *Tamiasciurus douglasii*, *Thomomys bottae*, *Perognathus californicus*, *Peromyscus maniculatus*, *Peromyscus boylii*, *Neotoma cinerea* and *Microtus montanus*. During the investigation 647 individual mammals were captured 1743 times; *Eutamias quadrimaculatus* represented one-sixth of the individuals and one-third of the total captures.

Variations in numbers.—Table 1 shows the number of trapping days, the number of traps operated and the number of chipmunks captured, for each month. One trap set for one day equals the trap unit referred to in the table. One hundred and eight long-eared chipmunks were caught 514 times. One hundred and two were marked and released; of these, 70 percent were recaptured an average of 6.7 times per animal. Of the mammals marked in the area the chipmunks had the largest percentage of returns and also averaged the largest number of returns per animal.

Records for the separate months are not strictly comparable because the trapping area was continually expanded until the last of September, and some of the most rugged, heavily-wooded area was abandoned. The work, however, was done in the same locality and the only area added adjoined the old trap locations.

TABLE 2.—*Summary by sexes of the chipmunks captured*

MONTH	NO. OF ANIMALS	NO. OF CAPTURES	NO. OF CAPTURES PER ANIMAL
August			
Males	24	42	1.6
Females	25	57	2.1
September			
Males	28	58	2.1
Females	31	92	3.1
October			
Males	29	103	3.6
Females	27	92	3.4
November			
Males	11	34	3.1
Females	9	36	4.0

Captures for August, September, and October included 49 or more individuals each month; but less than half that number was taken in November. The drop in numbers captured is more significant when correlated with the number of traps set. It took one and one-third more traps to catch a chipmunk in November than in August, and nearly one and two-thirds more traps than in September. Fewer chipmunks were daily seen in November than in any of the preceding months. This suggests that they were in fact less active; some of them may have begun to hibernate. Among the 40 individuals captured between October 15 and November 16 only one was unmarked and presumably new. A possible explanation might be a restriction of range which would not only limit the movements of those chipmunks already established in the trapping area but also would prevent others from wandering into it.

Sex ratios and different activity of the sexes.—Of the total individuals taken 52 percent were males. Table 2 shows that nearly equal numbers of both sexes were taken each month, and that they were recaptured, on the

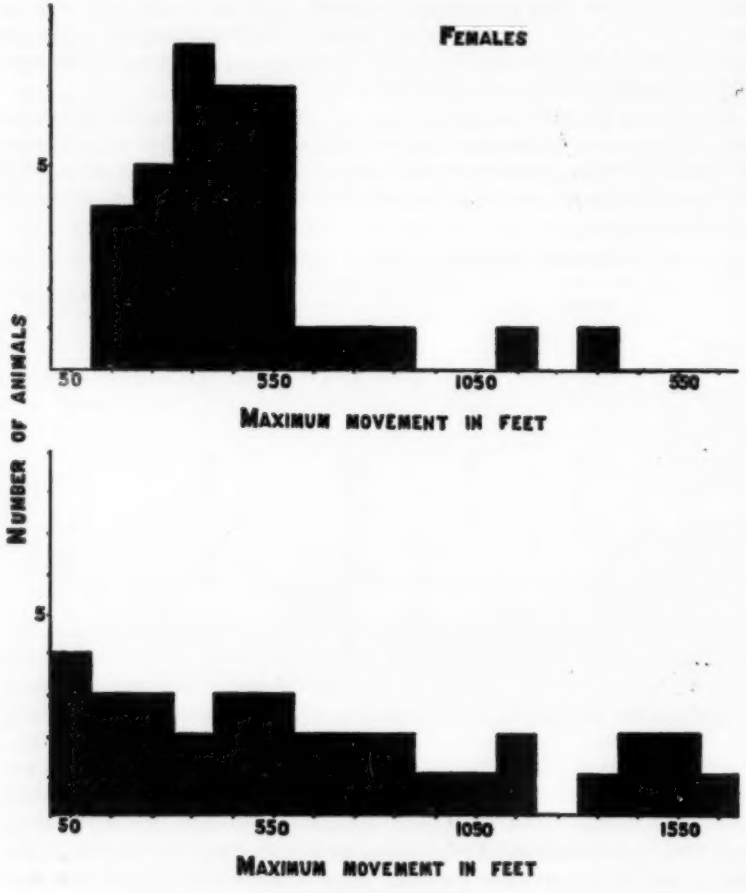

FIGURE 1

MAXIMUM MOVEMENT OF MALE AND FEMALE CHIPMUNKS

average, about the same number of times. This seems to indicate that the sexes reacted similarly to the traps and that there was a 1:1 sex ratio. After September 1 the young chipmunks could not be distinguished with cer-

tainty from the adults. For this reason the ratio of young to adults could not be calculated.

Figure 1 shows graphically that two-thirds of the females made maximum movements of from 400 to 600 feet. (The maximum movement of an animal, as used in this paper, is the distance between its two most widely separated places of capture.) Only 14 percent of the females moved more than 600 feet, while 48 percent of the males moved at least this far. Only two females moved over 800 feet, but fifteen males moved from 900 to 1700 feet. The average maximum movement was 456 feet for females and 700 feet for males.

It is possible only to speculate on the reasons for this apparent difference in maximum movements of the sexes. The males may not have been as tolerant of each other as the females were and may have forced each other to range over a larger area than was used by the females. Another suggestion is that the females may have been antagonistic toward the males during the period of gestation and lactation. If the males responded by avoiding the females, they may have been forced to extend their ranges beyond the limits of the individual female ranges. During August some of the females were nursing young and may have been more closely attached to their burrows than the males. Also the males may have anatomical and physiological peculiarities that give them a greater wandering tendency.

Relationship of maximum movement to home range.—The maximum movement is a linear measurement, while home range refers to a measure of area. Since the area of a home range is likely to be irregular and flexible, it is difficult to measure; it was not possible from the data collected to indicate the boundaries of any home ranges. The maximum movement, however, seems to represent the longest axis of a home range, as shown in the following cases:

1. A male (FR2-HL1) made a maximum movement of 720 feet but was captured several other times in traps nearly as widely separated.
2. A male (FR2-HL4) made a maximum movement of 1440 feet between September 6 and 28, yet its first capture on September 2 was only 180 feet from its last capture on October 5.
3. An immature female (FR1) was taken on August 10 at a distance of 450 feet from its first capture on August 9. On August 15 it was taken again at the place of its first capture and on August 16 it was captured 270 feet away.

The movements of these chipmunks show that they frequently make daily movements of 300 or 400 feet. Observation of foraging chipmunks indicated that they moved 100 to 150 feet in two or three minutes.

Food habits and relationships to other animals.—Several times ground squirrels (*Citellus beecheyi*) were noticed scratching on the sides of traps containing chipmunks; the latter barked excitedly. On one occasion a lively chase resulted after a ground squirrel had knocked over a trap and allowed the chipmunk to escape. It pursued the chipmunk for several hundred feet to a pile

of dead limbs where the chipmunk disappeared. The ground squirrels were never seen molesting untrapped chipmunks, and the two species were rarely seen in close association.

The chickarees (*Tamiasciurus douglasii*) cut many more cones from the trees than they consumed. The partially eaten cones of the white fir were torn apart and left in piles alongside or beneath their feeding stations. Chipmunks frequently searched these piles and recovered many of the seeds. After the first of September chipmunks were active in cedar trees twenty or thirty feet above the ground, working among the terminal twigs from which they collected the cones; these they took back a foot or so into the tree and broke open; then they gnawed the seeds out of the wings, and allowed the wings as well as the cones to fall to the ground. The chipmunks also gathered many of these cedar seeds under trees where they had fallen in large numbers while chickarees and gray squirrels (*Sciurus griseus*) had been gathering them. Several times chipmunks were seen tearing off loose flakes of bark from the trunks of young cedar trees, then licking the freshly exposed trunk surface, probably to get the soft resin. They foraged in trees at this time of the year more than is generally supposed. Grinnell (1933, p. 132) writes in reference to *E. quadrimaculatus*: "Lives about brush patches and logs" and "seldom goes up into trees and then to a height of only a few feet above ground." Grinnell and Storer (1924, p. 188) mention that on several occasions individual long-eared chipmunks were seen well up in trees.

In spite of the abundance of black oak acorns, the meats were found only twice in the cheek pouches of chipmunks. These chipmunks were never seen in groups about oak trees, though it was common to see two or three at a time foraging beneath a cedar. Though they may have been used quite extensively, the pits of dogwood (*Cornus nuttallii*) drupes were found only in one cheek pouch. As early as August 1 and as late as November 2 gooseberry seeds were found in cheek pouches. During the four months of this study these seeds probably formed the major part of the chipmunks' diet.

On October 10 a Tahoe chipmunk (*Eutamias quadrivittatus frater*) was captured in the encircling line. By the end of October, eleven of this species had been taken. All of them were captured in the north section of the trapping area, and none was ever seen in the grid itself. This is apparently an indication of a restricted movement into a new area. About this time the long-eared chipmunks were becoming less active than they had been in the summer, possibly allowing the intrusion of this near relative.

Mortality.—No dead chipmunks were found on the trapping area except those that had died in the traps. An analysis of the causes of mortality is given below.

(a) Faulty technique. During the first ten days of the work, the chipmunks were anesthetized before being handled. One of the animals died from over-anesthetization.

(b) Exposure to heat. Over-heating in traps set unsheltered from the sun caused two deaths.
(c) Exposure to cold. Sometimes chipmunks entered the traps late in the day after the afternoon catch had been released. By the morning they were usually cold and stiff. All but three of these cold animals were revived either by holding them in the hand for 15 to 20 minutes or by placing them for a short time in the sun where they became warm again. A couple of hours after they had recovered enough to eat they were always normally active.
(d) Entered unset traps. One chipmunk got into an unset trap and was not found until it was partly decomposed.

Thus seven chipmunks died directly as a result of the trapping. Of the 514 captures only one and four-tenths percent resulted in death; and these dead individuals represented only six and one-half percent of the 108 chipmunks taken during the study.

Conclusions.—The results of this investigation show that chipmunks can readily be studied with considerable success by trapping and marking methods. This particular study was not designed primarily for chipmunks, yet the degree of success, as indicated by the percentage of returns and the number of captures per animal, was greater for them than for any other mammal taken in the course of the work. It is reasonable to suppose that a concentration of effort on chipmunks alone would have produced better results.

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THE LEAST WEASEL IN MICHIGAN

By Robert T. Hatt

The least weasel, *Mustela rixosa* (Bangs), smallest of known carnivores, has been shown by Glover Allen (1933) to be a circumpolar species occurring from Norway through Siberia and southwards to northern Italy and the Caucasus. It also occurs in Japan. In North America its distribution is from Alaska southwards to Montana and Nebraska, through Minnesota, Wisconsin, northern Illinois, Indiana, and Ohio, southeastern Michigan, western Pennsylvania, and the mountains of North Carolina. Over this enormous range it appears to be sporadically distributed, or so uncommon, except at occasional times and places, that it is rare in collections; in many of the States included in its range, it was unknown until this century. In many large areas where it might be expected, it is as yet unrecorded. Among these are South Dakota, Iowa, northern Michigan, southern Ontario, New York, West Virginia, and Virginia. It was reported in Minnesota as early as 1857, and the eastern subspecies was described from western Pennsylvania in 1901. 1904 found it reported in Ohio, 1905 in Nebraska, 1907 in Wisconsin, 1916 in North Carolina, 1925 in Illinois, 1927 in North Dakota, and 1928 in Indiana. Covert, in 1881, (Covert, Adolphe B., 1881, Natural History in "History of Washtenaw County, Michigan," p. 193) listed five species of weasel under names which today are not all readily assignable. One of these was indubitably the least weasel, but his specimens appear to have been lost or destroyed. Ned Dearborn, then at the University of Michigan's School of Forestry, in 1932 recorded the first Michigan specimen which can be verified today. This was caught by a cat at Rochester, in Oakland County. In March, 1936, I secured a second specimen from a cellar hole in Bloomfield Hills, Oakland County, and shortly after that, a mounted specimen from a farmer in Rochester. Fourth and fifth specimens were secured at Rochester in the winter of 1936–1937. A fur dealer of that town had received six that same winter, the first he had ever seen.

With a view to the possibility of establishing a state-wide distribution for the species, it was decided to canvass the fur dealers of the state for additional records and specimens.

To each of the 500 licensed fur dealers of Michigan an envelope was sent February 9, 1939, containing a letter stating that I was interested in determining the distribution of the least weasel in Michigan; a brief definition of the species which did not contrast it with other species occurring here; a sign for placing on a wall where trappers would see it, showing a picture of a least weasel, offering fifty cents a head for the first six specimens from any county, and giving directions for mailing; a government post card with form to be filled out stating how many least weasel skins had been seen from what

county, how many such skins had been handled the season then closing, a place for additional information and signature.

The returns on this first questionnaire were not spectacular. Only 45, or 9 percent of the post cards were returned.

A second questionnaire was sent to the same persons on October 10, 1939, more specifically identifying the least weasel, and showing by full-scale sketches the differences in the tails of three weasels found in Michigan. Again a return card was enclosed, but, chiefly no doubt because no trapping season had intervened since the last questionnaire and no request was made to delay answer, little additional information was obtained. Only 16 of the 500 cards were returned, but as was hoped, additional specimens trickled in as a result of this pre-season prompting.

Returns on the thousand cards mailed were 61, or 6.1 percent. Of these not less than 13 were worthless through confusion concerning the distinctness of the species.

An instance in which apparently reliable returns from different dealers, reporting and denying the presence of the weasel in one county, is characteristic. A card from Tuscola County reported that sixty-five large weasel skins had been purchased in the season to February 17, 1939, but that no least weasels occurred in that section of the county. Another dealer nearby reported in the same week that the only least weasels he had seen were five taken in 1936—the smallest, $4\frac{1}{2}''$ long, the largest, $6''$. Four of these were white; one, brown.

In 1939, I received specimens from trappers in Bird Lake, Hillsdale County; Horton, Jackson County; and Deckerville, Sanilac County. The present year brought them from Disco, Macomb County; and another from Romeo in the same county. Besides the ten specimens recorded above I have been informed by Dr. William H. Burt of the University of Michigan that a living individual that he examined was caught September 12, 1938, in Bridgewater Township, Washtenaw County. Another weasel was near this one at the time of its capture. Another record is that of Durward Allen (see p. 459) who secured six young plowed out in Allegan County in July, 1939.

LOWER PENINSULA

Scattered records indicate the presence of the least weasel north at least to the Manistee River. Beyond this, to the Straits of Mackinac, are no reports of any kind, although questionnaires were sent to 28 dealers in this area.

The northernmost report was from a dealer in Cadillac, who buys in Wexford, Missaukee and Osceola Counties. This reads: "We have had numerous weasel pelts offered to us that we did not buy. Two pelts I am sure were least weasels. Others may have been, but don't believe so." Two other dealers report having seen a single specimen, each, in Osceola County.

Apparently reliable reports came from the following counties (no specimens seen): Barry, Branch, Cass, Eaton, Gratiot, Hillsdale, Kalamazoo, Lenawee, Oceana, Saginaw, Shiawassee, St. Joseph, Tuscola, Wayne.

Counties in lower Michigan from which individual dealers reported the

least weasel unknown are: Calhoun, Clinton, Isabella, Kent, Lapeer, Livingston, Mason, Mecosta, Montcalm, Muskegon, Ottawa, St. Clair, Van Buren.

UPPER PENINSULA

In the Upper Peninsula, a region containing little settlement and much game, there were 24 of the 500 licensed fur dealers, or about 5 percent of the lot. Only two of these responded to the questionnaire. One in Gogebic County, on the extreme west, reported no least weasels. The other, in Chippewa County, on the extreme east, wrote that in past seasons the least weasel ran about 20 percent of the weasel catch. This would be interesting if reliable; but it is best to conclude that there is at present no satisfactory record for the Upper Peninsula.

HABITAT

The least weasel is generally considered a feeder on mice, particularly meadow mice. In corroboration of this belief it may be noted that least weasels have frequently been taken from under corn shocks and in corn fields, where mice are often abundant. Swenk found that in Nebraska most specimens had been taken by farmers who ploughed them out in old stubble fields or in marshy ground.

The weasel's occurrence in and around buildings is probably accidental. That the animals may inhabit mouse-infested barns is to be expected. The first and second Illinois records and the second Michigan record came about through the animals' entering parts of structures from which they could not find escape.

Cahn found that in Quetico Park the least weasel was seen more frequently in the vicinity of small slow streams through hardwood growth, than in the evergreen forests about lakes. He concluded that apparently it prefers swampy areas to dense woods or rocks.

The least weasel of Bloomfield Hills was taken in a cellar areaway at the top of a morainal ridge two hundred feet from water, and within twenty feet of a thriving meadow mouse colony. Of the four specimens I have secured from Rochester, one was taken by a small creek, two by a ditch carrying a small amount of water, and the fourth in a fence row close to a small stream. The ecological source of the seven other specimens reported from Rochester is not known.

COAT

Sutton wrote that the many least weasels obtained in Pennsylvania under a bounty system included no specimen in a pelage intermediate between the summer and winter coats. Three of the specimens of Michigan weasels passing through my hands have been intermediate—one taken in the autumn (principally brown with beginnings of white), one taken early in February

(principally white with patches of brown), and one taken in mid-December (white except for the mid-dorsal line). Specimens secured November 29, December 11, January 22, and February 24 were completely white. Another, taken January 7, lacked any vestige of the white winter coat.

CYCLES OR RANGE EXTENSION?

The fact that Frank Butts, a fur dealer long established in Rochester, Michigan, never saw a least weasel before 1936–7, when six passed through his hands, may indicate a change in range or abundance. Gregory and Sanborn wrote of a trapper of Waukegan, Illinois, who obtained five in one winter—whereas he had never seen one before. At Inland, Nebraska, Swenk recorded a remarkable colony of least weasels discovered in 1916, when 35 specimens were taken; in the following year only eight were recorded; and in 1918, only two. From 1919 to 1923 no records were obtained, then one each in each of the following years. It could be predicated that any animal whose principal food resource lay in a rodent subject to marked cyclic fluctuation in numbers, would itself show rhythmic changes. The few records quoted above may thus find their interpretation. 1936 appears to have been a "mouse year" in Oakland County, and it may be no coincidence that the winter of 1936–1937 saw a relatively large number of least weasels taken.

Of the Michigan dealers' reports in my hands, one states that in Cass County two were seen in the season 1938–1939, none earlier. A dealer in Shiawassee saw three, all in one season. A Branch County dealer said the first he saw were in 1937–1938, when he bought ten. The following year he obtained fifteen.

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NOTES ON A COLLECTION OF MAMMALS FROM THE SOUTHERN COAST OF THE LABRADOR PENINSULA

By Richard Lee Weaver

During the months of June and July 1939 I traveled by boat from the village of Seven Islands to Blanc Sablon, along the north shore of the Gulf of St. Lawrence, in Quebec, and returned along the same route. During this time, I was a guest member of the annual patrol crew of the National Parks Bureau of Canada, engaged in inspecting the ten bird sanctuaries and the numerous eiderdown leases along the coast, as well as in enforcing the regulations of the Migratory Birds Convention Act. The project of systematic trapping of small mammals along the coast was by necessity of secondary importance; but the leader of the trip, Dr. Harrison F. Lewis, did everything possible to aid me, with the result that I was often able to trap at places where it would not have been feasible otherwise.

The characteristics of the region are so well described by Anderson (1924) that little need be said about geography, zones, or general ecology. Anderson points out, however, that there is a large area that "is zoologically very imperfectly known," and the knowledge of which, "must be built up by the observations and collections made by many individuals."

The region along the coast of the southern Labrador Peninsula has been largely neglected as far as the small mammals are concerned. Recent collections made by J. Kenneth Doutt and others of the Carnegie Museum, and by Dr. Robert Johnson at various places along the coast, by Dr. H. Eidmann (1935) in the region of Matamek at the head of Mosie Bay, and by Dr. Herbert Jackson and Dr. Robert Eadie for Dr. C. F. Jackson (1938), covering the area from Seven Islands eastward to near Cape Cormorant, have established some important distributional and taxonomic facts about the fauna of the area.

I was interested in several aspects of the mammalian population in addition to its distribution and taxonomy: primarily the abundance and fecundity of the different kinds. I am indebted to Dr. Glover Allen for help in the identification of the specimens, to Dr. Harrison F. Lewis for making the work possible and for his valuable suggestions, and to Dr. C. F. Jackson for reading the manuscript.

RELATIVE ABUNDANCE

During the course of the trip, which extended approximately 500 miles along the coast, I trapped at 17 localities on 30 nights or days. There were 795 trap nights and days (38 with rat traps, the others with standard spring-back mouse traps). Fifteen other trap nights were made with No. 1 steel traps for larger animals. The trip progressed eastward from Seven Islands to Blanc Sablon from June 1 to June 26. The return westward journey then began. It continued until July 23.

The following table gives the names of the localities, the dates of the trapping, and a tabulation of the results. The specimens are deposited in the Dartmouth College Museum.

TABLE 1

DATE	LOCATION	TRAP NIGHTS	MICROTUS PENNSYLVANICUS	PHENACOMYS UNGAVA	SOREX CINEREUS MIRUS	CLETHRIONOMYS GAPPERI	CLETHRIONOMYS G. PROTEUS	ZAPUS HUDSONIUS	PEROMYSCUS MANICULATUS	SCIURUS HUDSONICUS	MUS MUSCULUS	TOTAL
June 1	Seven Islands	23			1	1						2
2	"	20										0
5	Mingan	32			1	1						2
7	Havre St. Pierre	32									1	1
9	*Betchewan	15										0
12	Natashquan	14										0
15	Wolf Bay	30										0
18	*St. Mary's Island	30	1									1
19	*Harrington Harbor	30	3		2							5
20	" " (day)	30	8									8
20	" " (night)	30	5									5
21	" " (day)	42	3		1							4
21	" " (night)	42	1	2								3
26	Bradore Bay (day)	16										0
27												
27	Belles Amour	37			2			1				3
29	Kecarpoui	39					1	3				4
30	Mutton Bay	30	1		1			3				5
July 3	Cross River	24										0
4	"	29	(1)									1
5		27					3			(2)		5
6	"	27					2					2
10	*St. Mary's Island	22	1									1
11	" "	22										0
12	" "	21	2									2
15	*Bluff Harbor	18	1									1
16	" (day)	18	5									5
16	" (night)	18	2									2
18	Washicoutai	18					3					3
20	Natashquan	22	3						1			4
21	Johan Beetz Bay	19	4					2				6
23	Havre St. Pierre	18			1						3	4
		795	43	2	9	2	9	6	1	2	4	79

* Islands.
( ) Not trapped.

Contrasted with the conditions found by Jackson (1938) during the summer of 1937, the meadow mouse was by far the most numerous mammal and the white-footed mouse was the least numerous in 1939, if judged by the number of specimens trapped. This may be explained by the fact that 338 of the 795 trap nights occurred on islands, where 34 of the meadow mice were captured. Most of Jackson's collecting was done on the mainland. It has been observed by Dr. Harrison Lewis and others visiting the coast that island populations are quite often different from those on the mainland. It will be noticed that if just the specimens from the mainland are considered the relationship of equal proportions of meadow mice and Labrador red-backed mice found by Jackson also prevails in 1939, for on the mainland, nine of each were captured. The fact that the white-footed mouse was found to be most numerous in 1937 and least numerous in 1939 cannot be explained similarly. In this case, the important factor is probably the extent of the range of this species. Few if any have been taken east of Natashquan, where my only specimen was captured. Only a small number of the trap nights were west of Natashquan but even so more specimens were expected.

As Dice (1931) points out, most of the methods for determining abundance are fallacious to some degree, especially if the same methods are applied to various species of animals, so the present index by the use of trap nights is not very accurate. It may be useful, however, as a means for general comparisons. Certainly the small number of mammals under consideration reduces the significance of the population data. The traps were identical in construction, all set by the same person, and in about the same manner, with the same baits used throughout. Various habitats were sampled at each of the seventeen localities.

ANNOTATED LIST OF SPECIES

Sorex cinereus miscix Bangs. Labrador long-tailed shrew.—Jackson (1938) established the range of this shrew as extending from the Atlantic coast several hundred miles to the westward. My nine specimens were taken in the region where Jackson collected. They were not found in all conceivable habitats (Jackson, 1938; Bangs, 1896) but were rather restricted to those areas having some spruce growth. Only three of the nine specimens were taken on outer islands. One male specimen was found to be molting on July 1, a date which, according to Jackson (1938), is nearly a month after the spring molt should have been completed.

Sciurus hudsonicus hudsonicus Erxleben. Northern red squirrel.—Two were shot on Cross River, one-half mile inland, and one was observed at Kecarpoui at least one mile inland. In both places the trees were from ten to twenty feet in height. Very few squirrels are seen along the eastern part of the coast, where the spruces are stunted and form only low dense thickets in the hollows.

Peromyscus maniculatus maniculatus (Wagner). Hudsonian white-footed mouse.—This species was nowhere abundant; one specimen was taken at Natashquan.

Phenacomys ungava ungava Merriam. Ungava phenacomys.—The two females were taken at Harrington Harbor, June 22, in an area that is unforested, except for occasional clumps of stunted spruce. The ground was covered with a thick mat of lichens; there were many rock outcroppings. A small brook and several ponds were present.

One female had four well-developed embryos while the other was a non-breeding adult. The latter had lost half of its tail. These specimens were allocated to this subspecies by Dr. Allan after comparison with the specimens of *Phenacomys ungava crassus* in the Bangs collection.

Clethrionomys gapperi gapperi (Vigors). Red-backed mouse.—This subspecies evidently extends eastward along the coast to about Seven Islands and Mingan, although Jackson (1938) found all forty of his specimens to be *C. g. proteus*. The two males collected were from Seven Islands and Mingan and were allocated to this subspecies by Dr. Allen.

Clethrionomys gapperi proteus Bangs. Labrador red-backed mouse.—Nine specimens of this subspecies, as well as the two *C. g. gapperi*, were taken in spruce woods on the mainland. This subspecies was not taken east of Kecarpoui or west of Washicoutai. One female trapped at Cross River had five well-developed embryos on July 6. Three immature males were taken at Washincoutai, July 19.

Microtus pennsylvanicus pennsylvanicus (Ord). Meadow mouse.—The forty-three specimens collected have been allocated to this subspecies rather than to *Microtus pennsylvanicus fontigenus* Bangs, because of the very questionable status of the latter. At the suggestion of Dr. Glover Allen, a careful comparison was made between my specimens and those in the Museum of Comparative Zoology collected by Bangs and Miller, one of which is the type specimen of the questionable form. All of the specimens in the museum, including those upon which the original description was based, were immature specimens taken in the fall. As was expected by Dr. Allen, the adult skins of my series were indistinguishable from many of the darker *Microtus* specimens taken in Massachusetts and other areas to the north. My specimens were darker and averaged larger than the four topotypes of *M. p. pennsylvanicus*.

Microtus pennsylvanicus fontigenus was supposed to be smaller and darker and have rounder bullae than *M. p. pennsylvanicus*. My adult specimens are as large, and if anything larger, than typical *Microtus pennsylvanicus* and are not darker than the darkest ones of this species, nor do the skulls of the adults differ noticeably. The nine specimens in the Bangs and Miller collections averaged: Length, 141 mm; tail, 36.7 mm; hind foot, 19.1 mm. The four topotypes of *M. p. pennsylvanicus* averaged: Length, 157 mm; tail, 38.2 mm; hind foot, 21.9 mm. Ten breeding specimens in my collection averaged: Length, 180.5; tail, 41.3; hind foot, 21.9. Ten of the largest specimens from the Dartmouth College Museum of *M. p. pennsylvanicus* collected in New Hampshire and Vermont averaged: Length, 160.5; tail, 45.7; and hind foot 20.8.

Because of the lack of trenchant skull differences, and the similarity of color and size between my specimens and typical northern specimens of *Microtus pennsylvanicus*, I do not feel that *M. p. fontigenus* (Bangs) is a valid subspecies.

This meadow mouse was the most numerous of the mammals collected. It was more numerous on the islands than on the mainland. Of the total of 43 specimens taken only 9 were from the mainland. Eight of the 43 were found to be molting and to represent all stages of the molt. Four females had 9 embryos each, one had 8, one had 7, and one had 6. Of 11 adult males the testes averaged 16.3 mm. in length. The one female having 6 embryos trapped July 21, had 4 well-developed embryos on one side and 2, which were only one-half as large, on the other side.

One interesting observation was made directly after a heavy rain storm at Bluff Harbor. Four males were taken during the early morning, two young males during the day, and then these were followed by an adult male and a female during the night. While inspecting the Fog Island Bird Sanctuary, I noticed a tuft of light green shoots 6 or 7 inches tall. When unearthed these proved to be growing from about half a bushel of juncus bulbs that had been stored by the mice. All of the specimens except one were taken where the predominant vegetation consisted of mosses (usually sphagnums) and

various lichens. Bangs (1896) found these mice usually along the banks of the little spring brooks in deep forest, or in small sphagnum bogs where they lived under old logs or in holes in the moss. My specimens were taken more generally than this, especially in the open areas. On some of the islands hundreds of runways could be detected, as well as winter midden heaps, but few mice were taken from these places. Lichens, when disturbed in dry seasons, will retain the marks of runways, footprints, and other disturbances for many years. Therefore, the runways noticed may have been made some years ago. Miller (1897) and Bangs (1896), in discussing *M. p. fontigenus*, found no runways similar to the ones made by *Microtus pennsylvanicus* to the south.

Before I trapped at Harrington Harbor, two boys, instructed and equipped by Dr. Robert Johnson, had collected 38 specimens of meadow mice and had made flat skins of them to sell to the tourists. They had secured few other species. F. W. Osborne, caretaker of the St. Mary's Lighthouse and Bird Sanctuary, had trapped numerous mice in 1938 and had obtained one partially albino specimen, which he gave to me.

Zapus hudsonius hudsonius Zimmerman. Hudson Bay jumping mouse.—Although Anderson (1934) gives the range of *Z. h. ladas* as from Godbout around the coast to Hamilton Inlet, Dr. Allen considered the six specimens taken from these three localities, Belles Amours, Kecarpoui, and Mutton Bay, to be *Z. h. hudsonius*. These mice were usually found near streams, in birch or spruce thickets and often near or in rocky outcroppings. One female had 5 large embryos; 4 adult males had testes averaging 7 mm. in length.

Mus musculus Linn. House mouse.—Four specimens were taken at Havre St. Pierre, the largest of the coastal villages, having a population of 1300. One was taken under a building, while the others were trapped in the store-room of a local grocery store. These mice were not encountered elsewhere along the coast, but they undoubtedly exist, although Dr. Lewis thinks they are very rare.

OBSERVATIONS OF OTHER SPECIES

Observations of other mammals or mammal signs where no specimens were collected, included the following:

Phoca vitulina concolor (DeKay). Atlantic harbor seal.—Thirty-nine young seals, seen at Walrus Island near Havre St. Pierre on June 8, had been shot recently in the vicinity.

Ursus americanus americanus Pallas. Black bear.—Scats were observed on the mainland, near Watshishow Bird Sanctuary.

Mustela cicognanii cicognanii Bonaparte. Bonaparte weasel.—One had been caught at Harrington Harbor near the hospital several weeks before my visit June 19.

Marmota monax ignava (Bangs). Labrador woodchuck.—Two individuals were observed (also many signs and four freshly-used holes) along the coast one mile east of Cross River which is near Harrington Harbor. This is one-hundred and fifty miles southwest of the type locality (Black Bay, Newfoundland, Labrador).

Ondatra zibethica aquilonia (Bangs). Labrador muskrat.—Signs were seen at Mingan and Kecarpoui.

Erethizon dorsatum picinum Bangs. Labrador porcupine.—Signs were observed at Kecarpoui, one mile inland.

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MAMMALS OF AMELIA COUNTY, VIRGINIA

BY JOHN B. LEWIS

Amelia County is in the Piedmont section of Virginia, with its center approximately 40 miles west of the fall line, 60 miles east of the base of the Blue Ridge Mountains and 40 miles west and a little south of the city of Richmond. Its elevation ranges from about 200 feet where the Appomattox river leaves the county at the southeastern end, to nearly 500 feet on the high points near the west end. It has an east west length of about 32 miles and a north south width of about 18 miles. The surface varies from rolling to hilly. There is a large proportion of forest and cut over timber land. The Appomattox River forms the boundary on a part of the west end, all around the north side and on part of the east end. Two large creeks, Flat Creek and Deep Creek, cross the county to empty into Appomattox River. There are also a number of smaller streams, tributaries of the two large creeks. There are three large ponds, of which Beaver Pond, near the center of the county, 2 miles long and about 300 yards wide in the wider places, is the largest.

The following notes are the results of work done in Amelia County since January 1, 1937. A few notes were taken at earlier dates, as indicated. Trapping has been done in all sections of the county and in all types of terrain.

During parts of 1937 and 1938 the writer was employed by the Wildlife Research Unit of Virginia Polytechnic Institute in making a survey of the

plants and animals of the county. I am under many obligations to the late Arthur H. Howell, of the U. S. Biological Survey, and to C. O. Handley, Leader of the Wildlife Unit, for instructions and suggestions, and to Mr. Howell for checking the specimens and naming them.

Didelphis virginiana virginiana Kerr. Virginia opossum.—Fairly common all over the country, in spite of the fact that hundreds are killed by hunters every winter and many meet death on the highways. It dens in holes in stream banks, under the upturned roots of fallen trees, in hollow logs and stumps and the bases of hollow standing trees; also frequently in holes left in the ground by the decay of second-growth pine stumps.

The opossum will eat almost anything it can chew and swallow, including birds, eggs, mice, insects, frogs, tadpoles, crayfish, and occasionally poultry as well as many kinds of wild fruits. Often when snow is on the ground I have followed opossum tracks and found where the animals had eaten the large, globular mushrooms that grow in deep humus in our woods all winter. I have also found many tracks leading from their dens to the carcasses of dead farm animals, indicating that carrion is an acceptable food.

A very large male opossum that I had in captivity in 1928, consumed a 3 foot 8 inch black snake (*Coluber constrictor*) in a single night, leaving only 4 inches of the tail and a few shreds of skin. This fellow had the habit of spending much time sitting in his pan of drinking water. (See Journal Mammalogy, vol. 10, no. 2, May 1929, pp. 167–168.) An occasional opossum is found that is almost entirely black. Personally I have seen only one such, which I caught in Brunswick Country, Virginia, in the winter of 1925–26. The fur of this animal was solid black except for a sprinkling of white hairs that were slightly longer than the black ones.

Scalopus aquaticus aquaticus (Linneaus.) Eastern mole.—Common and fairly general in distribution in open lands throughout the county. Occasional in open woods near fields.

Sorex longirostris longirostris Bachman. Bachman shrew.—November 3, 1938, a specimen of this tiny shrew was caught in the edge of a small sphagnam bog, in an old field about one and a half miles north of Amelia village. Traps were kept at this place for ten days longer, and were put out again, a month later, but no more specimens were taken. Several other similar bogs were trapped in different sections of the county, but without success, until March 20, 1940, when a Bachman shrew was taken in a trap set at an entrance to a pine mouse hole near the base of a bank of an old mill race, in a mat of prostrate honeysuckle. This was in woods, near where I had taken several golden mice, *Peromyscus nuttalli lewisi*. The night of April 3, 1940, two specimens, male and female, were caught in traps set about 15 feet apart, in prostrate honey suckle in a small, wet swale, in open land just back of our residence. All four specimens were sent to Arthur H. Howell for identification, and are now in the Biological Survey collection.

Blarina brevicauds carolinensis (Bachman). Carolina short-tailed shrew.—This is our common shrew and is found almost anywhere, where there is cover. It is most common in woods and honeysuckle thickets, but is often taken in fields where there is a good growth of sedge grass, in either wet or dry situations. It is often infested with dormant, coiled nematodes (?), under the skin around the shoulders and hips.

Myotis lucifugus lucifugus (Le Conte). Little brown bat.—Five specimens were taken in a dairy barn on the north border of the county between July 7, and August 26, 1939. None have been shot, probably because they do not become active until after dark. A male taken August 26 was in breeding condition.

Myotis keenii septentrionalis (Trouessart). Long-eared brown bat.—One specimen taken in a dairy barn near Winterham, September 20, 1939, and sent to me by the pro-

prietor, Mr. H. J. Sheppard. Probably the habit of the two species of *Myotis* of flying low and only after dark, is at least partly responsible for their apparent scarcity.

Lasionycteris noctivagans (Le Conte). Silver-haired bat.—Six have been shot at dusk on the following dates: November 23, 1938, March 9, April 21, April 24, May 10 and October 24, 1939. Four were males, two females. The dates probably indicate that the species is a migrant only. It flies early in the evening, and with a steadiness that makes it an easy target.

Pipistrellus subflavus subflavus (F. Cuvier). Georgian bat.—Next to the red bat, this is our most abundant species. Seventeen specimens have been taken. The latest date at which they have been shot or seen was September 26. All specimens handled in late August and in September have been very fat. Two females, each containing two well developed fetuses were shot, June 21 and June 22, 1939. One of the young in the first specimen had a total length of 29 millimetres. The other was too badly torn by shot to be measured. The fetuses in the second one were, male 41, female 42 millimetres in length. The flight of the Georgian bat is comparatively slow and steady.

Eptesicus fuscus fuscus (Beauvois). Big brown bat.—Six specimens have been taken, five of which were caught in buildings; three in a dairy barn on the north side of the county and two in a residence in Amelia village. One was shot at dusk at the border of woods adjoining a pasture field. A large male collected August 26, 1939, had the testes enlarged and gave off a strong musky odor. They fight boldly when caught in the hand.

Nycticeius humeralis Rafinesque. Twilight bat.—One specimen was shot at early dusk, June 14, 1939, along Amelia Branch, about one and a half miles north of the village of Amelia. This was a female measuring 99 millimetres in length. Much subsequent shooting in that locality has failed to get another specimen of the species.

Lasiurus borealis borealis (Müller). Red bat.—The red bat is probably as numerous in Amelia County as all other species of bats combined. The number collected almost equals that of all the others, although after getting a good series, I avoided shooting at them as much as possible. They have been collected in every month in the year, as they fly at dusk of winter evenings whenever the temperature is 55 degrees or above. In summer they sometimes fly about in the middle of the day, even in bright sunshine. In late summer and early fall bats often congregate in large numbers at dusk about cribs that contain old corn, to feed on the *Angomois* grain-moths. At such times I have caught them in considerable numbers with a net. With the exception of one Georgian bat, all so caught have been of this species. When a moderate, steady wind is blowing over a moth-infested crib I have seen bats strung out in a narrow belt to a distance of 200 yards or more, catching moths that were carried by the wind.

Procyon lotor lotor (Linnaeus). Eastern raccoon.—Raccoons are locally common throughout the county in large tracts of forest land, most numerous along streams. Considerable numbers are caught each winter by hunters using trained dogs. Two specimens have been preserved.

Mustela frenata noveboracensis Emmons. New York weasel.—During my ten years residence in the county I have not seen a living weasel, and only one dead one. The dead one was secured by a friend whose dogs killed it while raccoon hunting at night. Unfortunately it was skinned before I saw it, and the head had been destroyed, but there is little doubt that it was of the species named above. Several farmers, in recent years report having killed weasels that came to their poultry yards.

Mustela vison mink Schreber. Eastern mink.—Not common, but seems fairly well distributed along streams. Tracks have been seen in mud and snow in a number of places. One was killed on a highway a half mile north of Amelia village in December 1938, as reported to me by a reliable person. Trappers get a few each season.

The night of November 24, 1926 was dark and cloudy, with a temperature slightly above freezing. Going out on the lawn at 8.30 I heard a series of vindictive screeches coming from a small, woodland stream about 300 yards away. The sounds were at once recognised as the screams of a mink, and as they were repeated at short intervals I lit a lantern and hurried down to the "branch."

The screeching continued at short intervals until I reached the bank of the stream a little above where the last outburst originated. In one of the intervals I heard a great splashing, followed by renewed screeching from a pool almost under my feet. Shining the light downward I got glimpses of two lithe, brown forms, tumbling over and over each other in the water with great rapidity and accompanied with much screeching.

Then the screams ceased and the combatants swam rapidly across the foot deep pool, one in close pursuit of the other. Then came the pattering of feet as the two animals raced diagonally up the hillside on the other side of the branch, punctuated with more screeching, when the pursuer overtook the pursued. And thus they went out of hearing.

Lutra canadensis canadensis (Schreber). American otter.—The otter is said to have been common along Appomattox River and the larger creeks up to about 30 years ago. It is now very rare. In late January, 1932, one was caught in a trap set at a slide on the bank of Appomattox River, on the north side of the county. On February 1, I saw the skin at the home of the trapper. Its total length, including the tail, was just four feet, but it may have been slightly stretched.

Dr. G. C. Eggleston, of Amelia village, an accurate and trustworthy observer, reports having seen an otter while fishing from the bank of Appomattox River in the spring of 1937. The otter is now protected by State law at all times.

Mephitis mephitis nigra (Peale and Beauvois). Eastern skunk.—Quite local in distribution. All of the trustworthy records I have of its occurrence are of animals killed or seen along the banks and bluffs of the larger streams. One specimen has been preserved, an adult male taken on the bank of West Creek, in the south central part of the county. Twice, I have had unmistakable olfactory evidence that active skunks had existed very recently along lower Deep Creek, near its confluence with Appomattox River. Skunks are probably increasing in numbers in the localities mentioned above, as those who hunt at night with dogs complain that their hounds run afoul of them much oftener than they did a few years ago.

Vulpus fulva fulva (Desmarest). Red fox.—Reliable fox hunters report having caught red foxes along the north border of the county.

Urocyon cinereoargenteus cinereoargenteus (Schreber). Gray fox.—Common in the more thinly settled sections of the county, and not infrequent in the best farming areas. I often get glimpses of them in my rambles through the woods and fields. One specimen, presented to me by a fox hunter friend, is now in the collection of the Wildlife Research Unit, Virginia Polytechnic Institute.

Lynx rufus rufus (Schreber). Wild cat; bob-cat.—Some hunters say that there are a few bob-cats in large tracts of forest along the Appomattox River on the north side of the county.

Marmota monax monax (Linnaeus). Ground hog; woodchuck.—Locally quite common along stream bluffs, especially in the north and east parts of the county. Its numbers are, without doubt, increasing. There are probably twice as many in the county now as there were ten years ago. Three were shot at their dens in May 1939. The largest of these, a female, was 24½ inches long and weighed 8¾ pounds.

Tamias striatus fisheri Howell. Fisher Chipmunk; ground squirrel.—Locally common but not generally distributed. Found mostly on hillsides in deciduous woods, often on the bluffs bordering small streams. One may spend many days tramping without seeing a chipmunk.

Sciurus carolinensis leucotis (Gapper). Northern gray squirrel.—Fairly common and well distributed in deciduous woods. As elsewhere the numbers fluctuate from year to year, probably because of variations in the food supply. It is interesting to note that while Amelia County is on the border line between *carolinensis* and *leucotis*, our subspecies is the northern one.

Sciurus niger neglectus (Gray). Northern fox squirrel.—Old resident hunters say that 30 years ago these squirrels were not uncommon; but there are no recent records of their occurrence.

Glaucomys volans volans (Linnaeus). Eastern flying squirrel.—Locally common in deciduous woods, where they nest in hollow trees and in the old holes of the larger woodpeckers. They seem to have a preference for nesting places near small streams, though in a few instances they have been found on hills a third of a mile from water. On rare occasions I have found them in outside nests, probably remodeled birds' nests. Occasionally they establish themselves in farm buildings. Mating seems to take place in December, as the males of two pairs collected December 8, and December 16, 1939, were in breeding condition.

During their nightly activities, and especially about the time of the first frosts in autumn, flying squirrels often utter a shrill call that may be described as a slightly prolonged chirp, ending with a falling inflection. I have heard this call most often on moonlight nights, but this may be due, in part at least to the fact that I am oftener in the woods when there is moonlight.

The distance they can glide seems to increase with the height of the take-off in an increasing proportion as the height increases. In other words, doubling the height of the take-off will considerably more than double the distance that may be glided. As their speed increases the downward curve of their line of flight seems to straighten out. It usually ends in an upward swing as they alight on a tree trunk.

They can guide themselves with great accuracy when gliding. Years ago some boys of my acquaintance undertook to destroy a colony of flying squirrels that had established themselves in the top of a large barn. When disturbed these squirrels usually glided to the base of a large tree that stood in a corner of the barn lot. One of the boys stationed himself at the foot of this tree with a short wooden paddle while the other frightened the squirrels out of the barn loft. The boy with the paddle found that the squirrels could easily dodge his blows and still alight on the tree.

Reithrodontomys humulis virginianus Howell. Virginia harvest mouse.—This dainty mouse has been taken in old fields in seven localities from the extreme east end of the county to Maplewood in the west. It seems to be equally at home on dry hills or in bogs, provided there is a thick growth of tall grasses or sedges. Two have been caught where sphagnum moss formed an undergrowth to the sedges and rushes in standing water. None have been taken in woods, thickets or cultivated fields.

They live in burrows to some extent, but I believe that a majority make their homes in nests of fine grass blades, on top of the ground in tall grass or sedges. The globular nests average larger than a croquet ball. I have never been able to trace runways more than a foot or two from a nest or burrow.

The fact that only in two instances have more than two been caught in the same place, suggests that pair occupies a definite territory. After catching a pair I have almost always had to move the trap to a new location 75 or more yards away before taking any more.

The largest specimen taken, a male measuring 127 millimetres in length, was caught at the border of a sphagnum bog. Of the 48 specimens taken, 15 were 120 millimetres or more in length. Ten of these were females, 5 were males.

Peromyscus leucopus noveboracensis (Fischer). Northern White-footed mouse.—Abundant in woods, thickets and brush-grown old fields throughout the county, prefer-

ring well-drained places. Occasionally enters residences or other farm buildings that are near woods. It is probably our most numerous native mammal.

In winter white-footed mice appear to feed extensively on the fruits of the coralberry, *Symphoricarpos orbiculatus*. I have often found the ground under these shrubs dotted with piles of the fruits from which the seeds had been taken, and caught the mice by setting traps there. In woods where these mice occur I have often found the berries of the common dogwood, *Cornus florida*, that had been gnawed open, through both pulp and seed shell, and the kernel removed. Although I have no positive proof, I believe this to be the work of white-footed mice.

Peromyscus nuttalli lewisi Howell. Amelia golden mouse.—Twenty-six specimens of the golden mouse have been taken in Amelia County in two localities about two and a half miles apart. Between January 30 and March 26, 1937, twelve were caught along the base of an earth bank that formed part of the dam of the old Hardaway Pond. The dam broke through many years ago, leaving only a shallow pool above it. The location is about one and a half miles west of Amelia village, near the Southern Railway, and also near the east branch of Nibb's Creek. The bank has a growth of fair-sized trees on its lower side, and is covered with honeysuckle, *Lonicera japonica*, on the upper side.

I caught three of these mice in my hands, in a nest built in honeysuckle supported by alder bushes, about 5 feet from the ground. These nest dwellers were about two-thirds grown. The other nine were trapped along the base of the bank in a space hardly more than 30 yards in length. Repeated trapping in that place since has failed to yield any more mice.

Much trapping was done in other similar, and apparently as suitable places in all parts of the county, but no more were taken until January 22, 1939. Then a string of traps was set along the bank of an old mill race, about two and a half miles down Nibb's Creek from the place where the first twelve specimens were taken. This ancient, man-made bank is also wooded, and in places, overgrown with honeysuckle. Traps were kept out along this bank and also along the wooded stream bluff across the creek from January 22 to March 16. Seven adult golden mice were caught on the old race bank, and two on the bluff opposite.

These 21 specimens formed the basis for the new subspecies described by Arthur H. Howell in the Journal of Mammalogy for November, 1929.

Late in February, 1940, traps were set along the old mill race near the spot where the specimens were taken in 1939, as well as along the bank for nearly a half mile farther down. Between February 29 and April 4, five more adult specimens were taken. Of the 27 specimens known to date, 23 are in the Biological Survey collection in Washington, two are in the collection of the Wildlife Research Unit of Virginia Polytechnic Institute at Blacksburg, Virginia, and two are in my private collection.

During the night of April 2, 1940, a trap on the top of the old mill race bank was sprung, dragged about 8 feet, and a mouse tail left in it. The next night a female golden mouse, minus the tail, was caught in another trap 56 yards farther down the bank.

Microtus pennsylvanicus pennsylvanicus (Ord). Eastern meadow mouse.—Abundant in meadows and wet swales, in old fields, and cultivated lands. Meadow mice are often very destructive to corn in the shock in fall and early winter, and to small grains while in the field. The population density is variable. Beginning with January 1, 1937, I trapped for them in many suitable places, but got only six specimens in three months. Early in the spring of 1938 they began to increase, and by December, 1938 they swarmed in all suitable places. Now, in the spring of 1940, they seem to be decreasing in numbers.

Pitymys pinetorum scalopsoides (Audubon and Bachman). Northern pine mouse.—Fairly well distributed, but in my experience never abundant. Forty-two specimens have been taken, most of which are in the collection of the Wildlife Research Unit, V.P.I. About as many have been caught in woods as in open land. Their burrowing

habits are interesting. In open fields they dig a network of tunnels an inch or two below the surface of the soil, and make openings to the surface at intervals of a few yards just large enough for them to pass through. I have often been able to follow these burrows by the openings for a distance of 50 yards or more. Sometimes they make use of mole runways, making the openings to the surface from them just as with burrows of their own digging. They probably use only mole runways that have been deserted by the first owners, as I have never caught a mole in a tunnel used by pine mice. In woods their tunnels are hard to follow, as the surface openings are in the dry leaves of the forest floor and very inconspicuous. I find them more difficult to trap than meadow mice or white-footed mice. If one digs down and sets a trap in their runways they are likely to dig around or under it, covering it with earth. Most of my specimens have been taken in traps set on the surface of the ground at the openings from the burrows. Those taken in woods have usually been caught on rather steep banks. This may be due to the fact that the openings are more easily found in such places. The damage they do in gardens by eating seeds and tubers is usually charged to moles by the gardiners.

Ondatra zibethicus subsp. Muskrat.—Found occasionally along the larger streams and ponds. Rarely builds houses in our climate, more often living in holes in the banks of streams or ponds. Muskrats are sometimes destructive to young corn growing in the low-grounds.

Zapus hudsonius americanus (Barton). Carolinian jumping mouse.—On October 26, 1935, a Mr. Greenwood, foreman of a highway gang, brought me a living jumping mouse that he had caught on the south border of Amelia County, near the Nottaway County line. Its nest had been torn out during road work, and, as the weather was cold, it was in a half torpid state. The skin was made up and submitted to Arthur H. Howell, who identified it as above. The skin is now in the Biological Survey collection. In the spring of 1937, a string of traps was set at the locality where it was caught, but no more specimens were taken, and none has been caught elsewhere in the county.

Sylvilagus floridanus mallurus (Thomas). Eastern cottontail.—Common throughout the county, its numbers varying considerably from year to year. In addition to the large numbers killed by hunters, it is a staple article of diet of foxes. Judging from the hundreds of owl pellets examined, it forms 90 percent or more of the food of the great horned owl.

Odocoileus virginianus virginianus (Boddaert). Virginia deer.—Fairly common in the large belt of forest land along Appomattox River, and in a few other large tracts of woodland. While botanizing in the wooded lowgrounds along the river I often see deer tracks. Our county game warden reported 40 deer killed in the county in the hunting season of 1938-39.

Amelia, Virginia.

MOLTING CHARACTERISTICS IN THE EASTERN COTTONTAIL RABBITS

By George P. Spinner

The study of the molting of the cottontail rabbits *Sylvilagus floridanus mallurus* (Thomas) and *Sylvilagus transitionalis* (Bangs) was begun in 1936 as a part of the ecological, life history and management study of these cottontails undertaken by the Connecticut Cooperative Wildlife Research Unit, Dr. Paul D. Dalke, Associate Biologist, U. S. Biological Survey, in charge. This study was made possible by cooperation between the U. S. Biological Survey, the American Wildlife Institute, and the Connecticut State Board of Fisheries and Game. Acknowledgement is made to Doctors N. W. Hosley, P. D. Dalke, and R. E. Trippensee, Professor A. E. Moss, and Mr. John Pearce for valuable aid in presenting this paper.

The collecting of the rabbits used in this study was done by the District Game Wardens of the Connecticut State Board of Fisheries and Game and by assistants and cooperators of the Research Unit. The animals were collected from all sections of the state during the period beginning March 29, 1936 and ending November 16, 1938. Each was given a serially numbered tag bearing the date, locality and other data. Because mutilated animals had to be excluded from the study, only 226 of the total number collected, approximately 375, were used. Forty-two of the pelts were made into museum skins while the flat skins were placed fur side down on drying boards and allowed to cure. The skins were fastened to the drying board while green by means of thumbtacks at the edges without distortion of the normal shape.

The method used in determining the course of the molt was to trace on a glass plate the outlines of the skin and of the molting areas, excluding the feet and the part of the head above a line drawn just under the eyes on the flat skin. The lines were then redrawn on tracing paper and measured in square inches by means of a planimeter. The molting areas were taken as a percentage of the entire skin.

Grange (1932, p. 115) found that the immature snowshoe hare, *Lepus americanus phaeonotus* (Allen), molted later than did the adult hare. To exclude immature animals from our study, eighty-five square inches of total skin area was set as the adult minimum. However, one female, *Sylvilagus transitionalis*, of 83.71 square inches of total skin area was included in the study.

The pelage of these rabbits consists of three types of hairs—(1) a soft, gray underfur, averaging 12 mm. in length and with a uniform diameter the full length of the hair; (2) a combination fur and hair averaging 19 mm. in length. This hair is exactly like the underfur on the lower two-thirds of its length, but the upper third has a greater diameter, is more stiff and is banded

black and white. (3) The third type is the black or banded black and white guard hair, averaging 32 mm. long and being of one diameter throughout its length except for a short narrowed basal portion.

Although there is great individual variation in each species, *Sylvilagus floridanus mallurus* can be distinguished from *S. transitionalis* by the more reddish tinge to the fur and also by the more heavy streaking or grizzling with black.

As seen from the flesh side of the skin, the molting areas are of two types, the dark or "blue" and the light or "cream." Toldt (1935) finds that these colors are caused by the pigment of the hair in the follicles, the black hairs making the dark areas and the white hairs the cream areas. In the photographs of the molt progression during several months (pls. 1–2) it will be noticed that there are two types of dark molting areas, namely, spotted areas and sheet areas. The skin which is nearest the average molt for both species during each month was selected for the photographs shown on pls. 1–2. Although the molting continues for a nine month period, February to November, it has two distinct phases, the spring and summer molt taking place from March to August and the fall molt taking place from September to November. The spotted molting areas are characteristic of the first molt and show on the fur side as bunches of new hair. The sheet molting areas are characteristic of the fall molt. The light or cream areas appear as tiny dots and fine lines in the spring molt but in the fall molt they become sheets like those of the dark areas.

The cause of molting is as yet undetermined. Hadwen (1929) concluded from the almost normal change of color in captive hares kept in a steam heated room for many months "that environmental factors can be ruled out." Bissonette (1939) found that the molting cycle of the mink, *Mustela vison* could be controlled by manipulating the daily period of light to which the animals were exposed. Hammond (1925) suggests that substances produced in the blood and necessary for the reproductive function may be used, in part, to carry on other metabolic processes. Some basis for this opinion was indicated in the present study.

A histological study of the testes shows male cottontail rabbits to be in breeding condition from January through August. A curve based on the average monthly weights of the testes shows that the testes begin to gain in weight during the nonmolting period, in December, and start to lose weight at the beginning of the molting period in April, the weight dropping off abruptly with the beginning of the fall molt in September.

It was also noted in the flat skins that all of the pregnant females taken during the months of September to November had spotted molting areas while all but one of the nonpregnant females taken during this period had sheet molting areas. It is logical to assume that the spotted molting areas are characteristic of the breeding season and the sheet molting areas of the nonbreeding season.

Although adequate data are still lacking, the study tended to show that the female molting period ends later than that of the male, a delay probably due to the long lactation period of the female.

Table 1 shows the percentage of molting area of both species, grouped according to months. As both species are almost identical in time and degree

TABLE 1.—*Percentage of molting area of both species by months*

	NUMBER OF RABBITS	PERCENT MOLTING AREA	STANDARD ERROR
January	22	.6	1.66
February	19	.4	1.44
March	30	1.3	2.06
April	16	4.9	5.39
May	18	25.9	10.32
June	21	26.3	9.60
July	21	11.5	6.98
August	9	17.9	12.78
September	18	42.7	11.65
October	14	47.2	13.36
November	15	13.4	8.78
December	23	.4	1.31

TABLE 2.—*Comparison of Connecticut and Michigan rabbit molt*

MONTH	CONNECTICUT		MICHIGAN	
	Number of rabbits	Percent molting area	Number of rabbits	Percent molting area
January	22	.6	6	.2
February	19	.4	5	.9
March	30	1.3	23	1.7
April	16	4.9	12	.2
May	18	25.9	3	28.4
June	21	26.3	1	8.5
July	21	11.5	5	13.8
August	9	17.9	2	20.0
September	18	42.7	10	58.5
October	14	47.2	13	38.3
November	15	13.4	19	7.8
December	23	.4	71	.2
	226		170	

of molting, it was felt that this grouping would give more significance to the standard error.

Table 2 shows the percentage of molt of both species and also the percentage of molt of the cottontail *Sylvilagus floridanus mearnsii* as given by Trippensee (unpublished thesis, 1934).

Examination of all rabbits for internal parasites was done by the Animal Disease Laboratory of the Storrs Agricultural Experiment Station. After

checking the molting percentage of the individual rabbit against these reports no basis was found for assuming that parasites affect the molt in any way.

CONCLUSIONS

1. The cause of molting is as yet undetermined.
2. The two types of molting areas as seen from the flesh side of the skin, the dark or "blue" and the light or "cream," are caused by the color of the hair growing in the follicle.
3. The annual molt of the cottontail rabbits is done in two distinct phases, the spring and summer phase characterized by dark, spotted molting areas and the fall phase, characterized by the dark, sheet molting areas.
4. Some indication was given that molting and the breeding period may be related.
5. *S. f. mallurus* may be distinguished from *S. transitionalis* by the more reddish tinge to the fur and by the fact that the *S. transitionalis* is more heavily streaked with black.
6. No basis was found for assuming that parasites affect the molt in any way.

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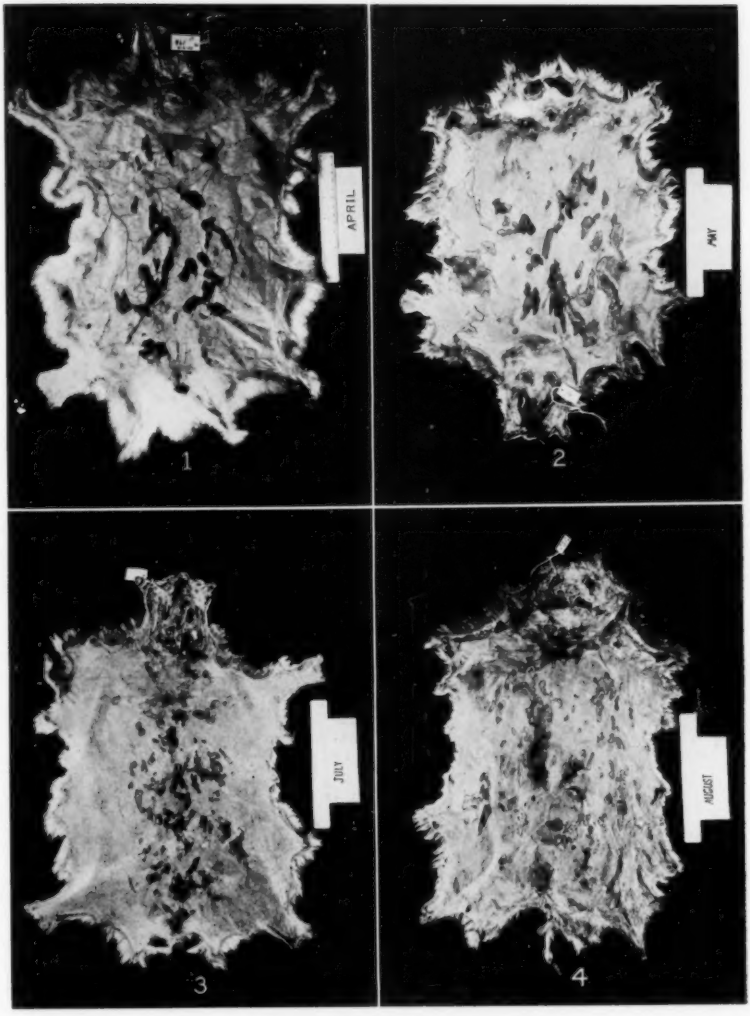

PLATE 1

Flat skins of cottontail rabbits showing extent of molting areas.
FIG. 1. Flesh side of April skin. FIG. 2. Flesh side of May skin.
FIG. 3. Flesh side of July skin. FIG. 4. Flesh side of August skin.

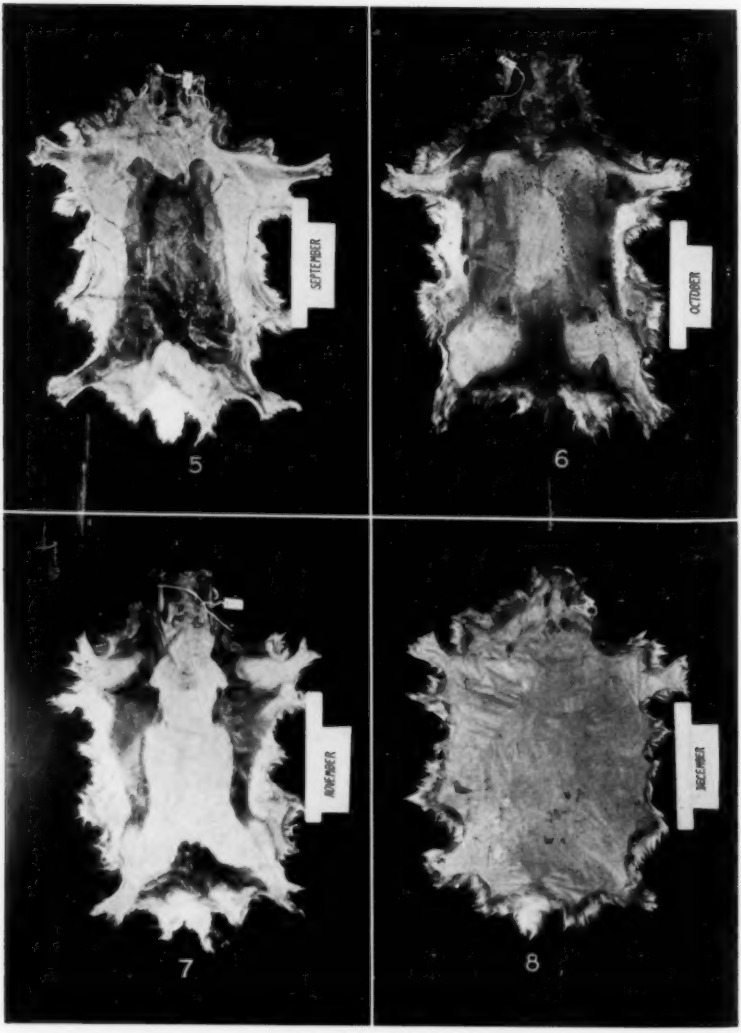

PLATE 2

Flat skins of cottontail rabbits showing extent of molting areas.
FIG. 5. Flesh side of September skin. FIG. 6. Flesh side of October skin.
FIG. 7. Flesh side of November skin. FIG. 8. Flesh side of December skin.

HABITS AND PELAGE CHANGES IN CAPTIVE COYOTES

By Eldon E. Whiteman

In an experiment with captive coyotes at Michigan State College, the following six animals were under direct observation: A male and a female taken from a den in Crawford County, Michigan; a male born to this pair; a male caught in a trap in Ontonagon County, Michigan; the history of the fifth and sixth (male and female) was not obtainable.

The animals were kept in cages that were either 8 by 8 or 12 by 15 feet.

Foods accepted and rejected.—Five adult coyotes were tested to determine the foods they accepted and rejected. Twenty-nine different foods, animal and vegetable, were tried, though it was not possible to give every one of these foods to each of the animals. With the exception of flying squirrel, bear carrion, mallard duck, and large-mouth black bass, no food was tried on fewer than three coyotes. Animal foods were obtained by trapping and by utilization of animals killed on the highways.

Accepted Foods

Meadow mouse	Cottontail rabbit	English sparrow
House mouse	Bear carrion	Chicken egg
House rat	Venison	Chicken
Southern red squirrel	Mutton	Dandelion
Fox squirrel	Mutton carrion	Grass
Flying squirrel	Mallard duck	Apple
	Large-mouth black bass	

None of the six rodents that were offered were rejected. Vegetable food was acceptable also.

Rejected Foods

New York weasel	Opossum
Mink	Coyote carrion
Common mole	Leopard frog
Star-nosed mole	Sheep spleen
Short-tailed shrew	Sheep lung

Food preferences.—This part of the experiment was to learn if coyotes prefer one food to another when two were available. Each coyote was placed in a separate cage and the two foods in question were placed side by side before the animal. Portions of meat of equal size were used when the case permitted. No live animals were used as a test food. In most cases the foods were nosed over well before a choice was made.

These coyotes showed a definite preference to mutton over rabbit. Both the mutton and rabbit were eaten on all trials except one, when one individual buried the rabbit after eating the mutton.

Preference was also shown for mutton over muskrat and for rabbit over venison. Mutton carrion was preferred just a little oftener than the fresh meat. The sheep entrails offered were not preferred to the flesh.

Breeding habits.—In the fall of 1937 observations of breeding habits were begun on the young pair born the preceding April on the Hanson Game Refuge, Crawford County, Michigan. Thus it was possible to make a study throughout their first breed-

NUMBER COYOTES TRIED	FOOD	NUMBER TIMES CHOSEN FIRST	FOOD	NUMBER TIMES CHOSEN FIRST
5	Mutton	35	Rabbit	3
4	Rabbit	12	Venison	0
4	Mutton carrion	16	Fresh mutton	13
2	Mutton	10	Muskrat	0
4	Sheep flesh	18	Sheep liver	7
3	Sheep flesh	9	Sheep lung	0
2	Sheep flesh	2	Sheep spleen	0
2	Sheep flesh	4	Sheep heart	1
1	Red squirrel	1	New York weasel	0
2	Meadow mouse	2	Common mole	0

ing season. This year the pair was kept in the same cage. On February 12, 1938, the female was discharging blood which continued fourteen days; however, no enlargement of the vulva had taken place. During this period the male did not show any interest in the female, and copulation did not take place, to my knowledge. No pups were born; perhaps one or both animals had not become sexually mature.

A year old female caught on February 20, 1938, White Oak Township, Ingham County, Michigan, showed no signs of external bleeding nor did she contain embryos.

A pair at the Museum of Zoology, Ann Arbor, Michigan did not breed their first year, but did the second (February, 1939).

Grinnell, Dixon and Linsdale (1937) report that a California trapper, J. O. Miller, had caught numerous one year old females which showed no signs of bleeding. Therefore, he concluded that many females do not breed until they are nearly two years old.

In the fall of 1938 the female was placed in one cage and the male in another. At intervals they were allowed together in the runway for exercise, but were always under observation. The vulva of the female was examined several times each week. On December 11, 1938 when the first discharge of blood was noted, the pair was placed in one cage. He mounted and made feeble attempts to copulate but she resisted. Thereafter they were permitted to be together in the runway for an hour each day. From the onset of bleeding to January 19 the loss of blood was not profuse and was very dark in color. During this time the male made numerous unsuccessful attempts to copulate. On January 19 the blood became a brighter red. By the 24th the color was very bright and bleeding more rapid. Hereafter all attempts by the male to copulate were more vigorous. On February 6 the vulva of the female became swollen for the first time. Its increase in size was very rapid, so that by the 8th, and until she bred, it was three to four times the normal size. During the last week of January and the first three weeks of February, the male was very impatient, becoming vicious at times. Fights were frequent.

On February 24 copulation took place, lasting for twenty minutes. This terminated her proœstrum which lasted for 74 days. The two following days she failed to stand, but was not hostile. On February 27, copulation again took place and lasted for 35 minutes. They were placed together for the next five days, but the male made no effort to mount. The œstrum in the case of this two year old female lasted for four days. After the mating the vulva gradually decreased in size and was about normal in 30 days. One male pup was born on April 27, setting the maximum gestation period at 62 days.

A female at George Reserve, Ann Arbor, Michigan, had a five day œstrum. She accepted the male from January 27 to 31, 1938.

F. F. Gander (1929) bred a coyote which took the male from January 26 to 29. Thus the oestrum lasted for four days.

The female at Michigan State College had a maximum gestation period of 62 days.

E. C. Brown (1936) reports the gestation period of a captive female at the Philadelphia Zoo to be 64 days.

Vernon Bailey (1936) reports the gestation period to be about 65 days.

G. W. D. Hamlett (1938) concludes that it is from 60 to 63 days.

Probably the coyote is monoestrous. The female observed came in heat only once a year.

On the basis of detailed histological study of both testes and ovaries, Hamlett (1938) concluded that the male is sterile during at least eight months of the year, the female during ten months.

The yearly mating of coyotes in Michigan appears to take place in midwinter. The female studied bred on February 24 and 27, 1939. The one at George Reserve, Ann Arbor, Michigan bred from January 27 to 31, 1938. The female at the University Museum, Ann Arbor, Michigan bred the last week in February, 1939. A female in the Jackson City Park was dropping blood on March 4, 1939.

The Study of young.—The pelage of the male pup born to the female at Michigan State College, was darker in color than that of an adult coyote. This dark color was uniform except for a darker streak down the middle of the back. The muzzle was pug and the ears limp.

The mother refused to let the pup be handled until he was 10 days old. On that day he weighed 1 lb. 5 oz. At 27 days he weighed 3 lb. 2 oz., and at 59 days, 6 lb. 14 oz. At the age of four weeks he was losing the dark puppy pelage and acquiring a pelage with the markings of an adult; his ears stood erect, and his muzzle had lengthened a little. At five weeks he was eating meat. He lacked a little of being fully grown by the following February.

Seasonal change in pelage.—The seasonal change in pelage was also observed on the pair taken from the Hanson Game Refuge. Data were collected for the intervening 18 months of January, 1938 to July, 1939. Skins of Michigan specimens from the University Museum at Ann Arbor, Michigan were studied in addition to the live individuals. This collection contained 31 skins representing all the months with the exception of July, November, and December. One skin was found for each of the months of April, May, June, and August. The remaining months were well represented.

The live pair of coyotes had a complete annual spring molt. The onset of shedding occurred late in February or early in March; however, the loss of hair in these months was slight. Throughout April and May there was a gradual increase in degree of molt, so that by June the loss of hair was profuse. Each completed its molt in July, thus requiring about four months to lose the old coat and acquire the new one.

Overhair and underfur were not shed simultaneously, but the loss of overhair preceded the loss of underfur. The ingrowth followed the same sequence. Shedding did not take place over the entire body at one time, but was confined to body areas in a definite sequence. The loss of hair on the tail and a patch at the base of the tail were the first indications of the onset of molting. The next areas to shed were the lower portions of the legs. From here the shedding process proceeded up the legs, then to the sides and finally to the back. The back and belly regions were last to shed.

The new pelage was composed of short, harsh overhair with a scant coat of underfur. The individual hairs of the underfur were also short. At this date both animals had the appearance of being extremely slender. During the months of August and September the overhair lengthened and the underfur became longer and denser. Thus by autumn these coyotes possessed a long, dense coat which they retained through the winter.

In making a month by month comparison of the pelage condition between the live coyotes and the skins of wild-killed individuals a similar state was found. The seven specimens taken in March had lost some hair on tail or rump or both, indicating the start of the molting period. Spring and summer were poorly represented; however, the specimens at hand indicated a shedding in spring and showed the new coat composed of short hair in summer. Fall and winter were better represented in the collection. The animals taken in these seasons possessed a fine coat made up of long dense hairs.

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Spring Arbor, Augusta, Michigan.

HAIR AND SCALES OF THE PACA

BY GLOVER M. ALLEN

It is well known that the adults of many species of the lower groups of mammals—marsupials, insectivores, edentates and rodents—exhibit on the backs of the feet or on the tail, horny epidermal scutes which are believed to represent the persistent vestiges of a completely scaly covering inherited from remote reptilian ancestors. An excellent illustration is found in the small South American mouse-opossums (*Marmosa*), in which Tate (1933, pp. 32-33) has shown that the scales of the nearly naked tail are arranged in either spiral or transverse rows. In the former case, apparently the more primitive, the scales are lozenge- or diamond-shaped, with blunted or rounded angles; in the latter case, however, the posterior median angle of each lozenge-shaped scale has become obsolete, resulting in a nearly transverse border. Each scale is subtended by a group of three appressed hairs, arising from the thin skin between each scale and the one next in front. The hairs vary in length according to the species. Thus in *Marmosa germana* they about equal the length of a scale but in *M. venusta* and others, in which the scales are transversely arranged, the hairs are longer, about three or four times the scale-length. The lengthening of the hairs therefore is accompanied by a slight reduction of the scales. In the house rats (*Rattus*) the tail is invested by transverse rings of squarish scales, again with groups of three short hairs between each two scales of the lengthwise series. These hairs are about as

long as the scale and are not usually abundant enough to conceal the scales from observation.

It is generally believed that the entire primitive mammalian body must have been completely covered with these horny scales, between which grew out groups of short hairs. With the increase in the length and number of the hairs, the scales gradually disappeared, so that in modern species the hairy coat has entirely supplanted the scales as a protective covering. Nevertheless the grouping of the hairs in little transverse clumps may still be traced on the bodies of higher mammals; this is regarded as further evidence of their original arrangement between successive rows of scales. De Meijere (1894) long ago called attention to these hair groups and their significance. The three-hair group he believes represents a primitive condition.

Later anatomists have sought to find traces of the scaly covering of the trunk in embryos of certain rodents, but apparently with uncertain success. Among some of the hystricomorph rodents, however, the occurrence of definite hair groups on the body has been demonstrated. Thus the late Dr. Alipio de Miranda-Ribeiro (1934, 1936) reported the groups of three in an embryo of a South American tree porcupine (*Coendu*). Römer (1930), a few years earlier studied a large embryo (head and body, 160 mm.) of the West African "ground-hog" (*Thryonomys*), one of the few Old World genera of hystricomorphs, and found similar groups definitely arranged in transverse bands, curving slightly backward. These hairs were in groups of three on the belly and the extremities but increased to five, eight, or up to twelve in a clump in the middle of the back. In these groups the central hairs are of about the same length as the lateral ones, although sometimes they are slightly the longest. Römer thought at first he could make out shallow skin folds corresponding to the outlines of scales; but from more careful examination he concluded that these folds were the result of shrinkage of the skin through the action of the preservative fluid. Weber (1927) has briefly summed up various general points concerning the hair groups, with diagrams, after de Meijere.

In the South American paca (*Cuniculus* or *"Coelogenys"*), a large agouti-like rodent of the hystricomorph section, the hair grouping has also been observed. Recently I have had occasion to examine the tanned skins of individuals about two-thirds grown (head and body, 560 mm.). I found that in places where the coarse brown hair of the back had been accidentally denuded, it was possible to make out very clearly that the skin was covered by distinct horny scutes, each of which, just back from its anterior border was perforated by a group of three bristly hairs. These horny plates occur over the entire body, but ordinarily they are largely concealed by the hair. They are of varying size and shape but average about 2 mm. in diameter. In outline, they are polygonal, with rounded corners, some rather distinctly hexagonal, others pentagonal, others again less regular. Many of them

show, under slight magnification, a small black circular mark near or just behind the center. Each scale is marked off by a depression in which the cuticle is thinner and pliable.

Projecting in a transverse row through each scale, slightly back of its anterior margin, are usually three coarse brown hairs, which, on the middle of the back, average a little over a centimeter long, with little or no marked difference between the central and the lateral hairs of each clump. Occasionally a group of four such hairs is found, but in general the normal number is three. They are slender at the base but soon increase to nearly twice their basal diameter, then taper at the free end. Often a much shorter

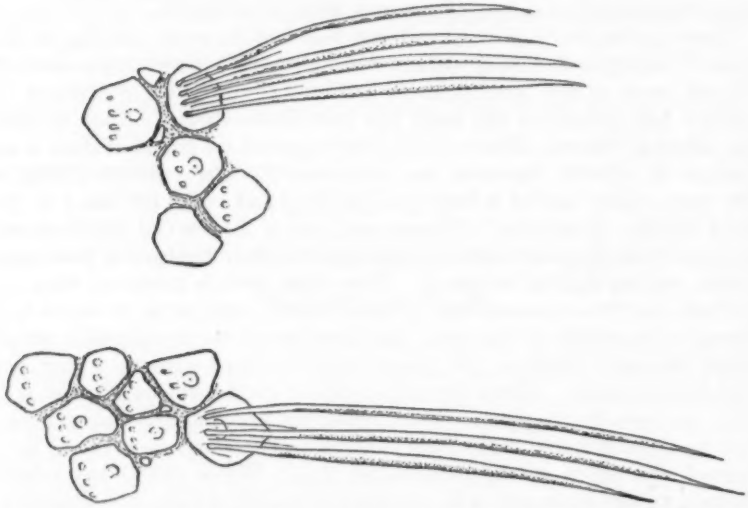

FIG. 1. Hair groups and scales from the back of a subadult paca (*Cuniculus paca*). For clarity, only two sets of hairs are drawn; the rows of three small circles on other scales indicate the exit of hair groups. × about 10.

and very slender hair is present between the central bristle of the group and the outer one; in addition very minute short filaments can be made out projecting from the surface of the scute, but without obvious system.

That the bristle hairs should project *through* the scale rather than between adjacent scales appears remarkable. However, on pulling a bristle hair gently forward, it was found that the follicle actually arose from the thin skin in the depression separating the scute from the one next in front. When pulled forward, the hair ruptures the front edge of the scute. Therefore it appears that the hair during growth must penetrate the scute. Römer states that in the tails of rats the hair appears before the scales are definitely

formed. If the same is true in the paca, the cornification of the scale may take place around the bases of the hairs after the hairs have grown out. Possibly the backward slope and appressed condition of the hairs may be thus partly accounted for. Skins of adult pacas show very little evidence of these horny scales which are so obvious in the half-grown animals, although the hair groups in threes can be made out readily.

In this rodent therefore, we have at last a case in which the primitive scaly covering is retained over the entire body well into postnatal life, with the primary group of three bristle hairs occurring in connection with each scale. In the fully adult, however, the distinctness of the scales is lost, just as it must have been in the phylogeny of the class.

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NOTES ON SOME MOLES FROM SOUTHEASTERN ASIA

By Gerrit S. Miller, Jr.

The Asiatic moles occurring in the region that extends from the eastern Himalayas (Sikkim) and eastern Bengal (Silhet) through Burma and Siam southeastward to southern Annam (Blao), eastward to northern Tonkin (Chapa), and northeastward to eastern Tibet and western China (Szechuan and Tonkin) differ in important particulars from true *Talpa* as represented by the central Asiatic *T. altaica* and the western *T. europaea*.

While the United States National Museum contains only 7 specimens of these southeastern animals (among them the types of the recently described *Talpa parvidens* and a new Chinese species) the kindness of the authorities of the American Museum of Natural History, New York, the Field Museum of Natural History, Chicago, and the Museum of Comparative Zoology, Cambridge, has enabled me to bring together a series of 27 more skins (25 with skulls), and one entire animal in alcohol, making a total of 34 specimens.

Examination of this material shows that the southeastern Asiatic moles represent two genera that are readily distinguishable from *Talpa*, namely, *Parascaptor* Gill, with one species, *P. leucura* (Blyth), and a new genus including *Talpa klossi* Thomas, *T. longirostris* Milne Edwards and their allies.

These two genera and the new Chinese species may be defined as follows:

1. Genus **Parascaptor** Gill

1875. *Parascaptor* Gill, Bull. U. S. Geol. and Geogr. Surv. Terr., ser. 2, no. 2, p. 110. May 14, 1875.

Type species.—*Talpa leucura* Blyth, from Silhet, eastern Bengal.

Range.—Eastern Bengal and northern Burma.

General characters.—Nostrils directed forward and surrounded by a large vertical muzzle-pad essentially as in *Talpa europaea;* tail shorter than hind foot, club-shaped, sparsely clothed with slender hairs the longest of which exceed the tail itself in length; genitalia superficially as in the other southeastern Asiatic moles (glans not seen); upper premolars 3-3, all distinctly larger (relatively to the length of the toothrow) and more trenchant than in *Talpa;* upper canine with an unusually lengthened base and large posterior cusp.

Specimens examined.—Three (American Museum of Natural History, Vernay-Cutting expedition) from northern Burma (Hpare, Pyepat and Gangfang).

Remarks.—The genus *Parascaptor* was established by Gill on the sole basis of the dental formula, that is to say, on the mere absence of one minute tooth in each maxilla. The seeming unimportance of this peculiarity as compared with the full 44-toothed dental formula of the Siamese "*Talpa*" *klossi* Thomas led Dr. Osgood to question the "normality" of the material on which Blyth's description was based. (Field Mus. Nat. Hist., zool. ser., vol. 18, no. 10, p. 243. August 19, 1932). Blyth, however, had two specimens, in each of which there were only 2-2 small premolars (Journ. Asiat. Soc. Bengal, vol. 19, p. 217, 1850). Dr. Anthony has now collected three more of these moles in northern Burma (some 200 kilometers west of Blyth's type locality), all with the same reduced tooth formula that Blyth described and figured. On the other hand, among 29 skulls of moles belonging to the group that includes "*Talpa*" *klossi* and "*T.*"

longirostris, the three small upper premolars are always present except in one instance ("*T.*" *klossi* No. 35384, Mus. Comp. Zool., from Mt. Angka, Siam) where the left middle (smallest) tooth of the three is defective, probably as the result of some injury. (A remnant of the root can still be seen.) In 62 specimens of *Talpa europaea* taken at random from the National Museum series there is no variation in the number of premolars; while among 6 *T. romana* I find one, No. 152148, U. S. National Museum, that lacks the median unicuspid tooth on both sides. As in the case of the abnormal "*T.*" *klossi*, however, the absence of these two teeth is accidental; traces of the alveoli are plainly visible.

When the small size and seeming mechanical unimportance of these three premolars is taken into consideration the constancy of the tooth formula in the moles of the talpine group seems rather surprising. Indeed, this constancy proves to be so great that I can see no reason to question the "normality" of the reduced number of small premolars in *Parascaptor* (now known to be constant in five specimens), particularly in view of the increased size of these small teeth (in relation to the toothrow as a whole), and the unusual trenchantness of their blades.

2. Euroscaptor, new genus

Type species.—*Talpa klossi* Thomas.

Range.—Southeastern Asia from the eastern Himalayas southeastward to southern Annam and thence northward to eastern Tibet and western China.

General characters.—Nostrils directed outward, one on each side of a small, hemispherical, forward-projecting median pad beneath which lies a lip-like transverse pad. Tail, except in *E. longirostris*, clavate, usually not longer than hind foot, the hairs at tip of tail usually longer than the tail itself. Genitalia differing from those of *Talpa* in the close approximation of the sexual and excretory orifices of both sexes, and in the form and armature of the glans penis.

Skull and teeth.—The skull and teeth are, in most respects, so similar to those of *Talpa europaea* that it is unnecessary to describe them in detail. In the upper molars there is a stronger tendency than in *Talpa* to develop the portion of the crown associated with the hypocone, a peculiarity that is especially well shown by *Euroscaptor klossi* nos. 37821 and 37822, Field Museum, from Thateng, southern Laos. Usually, though not always, a specimen of *Euroscaptor* can be recognized by this character alone and by the irregularly slanting posterior coronal border that it gives to the first and second molar teeth when seen in crown view.

Genitalia.—In contrast with the structures found in adult *Talpa* the genital and anal orifices are as closely crowded together as seems physically possible. This condition, in the adults of both sexes, is essentially the same as the one that Wood Jones has figured as occurring in a 9 mm. embryo of *Talpa europaea* (P.Z.S., 1914, vol. 1, p. 196, text-fig. 1, B.). In *Euroscaptor*, and probably in *Parascaptor* as well, the changes needed to produce the more highly specialized external ano-genital structure of adult *Talpa* (Wood Jones, text-figs. 5, male and 10, female) do not take place.

In *Talpa*, the glans is about 15 mm. in length and about 1.5 mm. in thickness. Its terminal 1.5 mm.–2 mm. is rapidly narrowed to a diameter of about 0.5 mm. The terete orifice is just large enough to permit the insertion of a small needle. The surface of the glans, except for an area of about 1.5 mm. at the tip and another about 4 mm. at the base, is encircled by about 40 somewhat irregular transverse rings of extremely minute, flattened, deeply trifid or bifid scales, the free edges of which are directed backward. The scales of the succeeding rows are disposed in quincunx order. At middle there are 20 or more of these scales to each ring. In a specimen of *Euroscaptor klossi* (no. 261090 U. S. National Museum, collected at Doi Pu Kha, Siam, by H. G. Deignan) the length of the glans is only about 5 mm., while the greatest width is fully 3 mm. The

extremity is not conspicuously contracted, its orifice is about 1 mm. in diameter, oblique, with a slightly crenulated margin, the overhanging edge dorsal when the organ is directed backward. The scales on the glans are much larger than in *Talpa*, all single pointed, their surface strongly convex from side to side, nearly straight from base to tip. There are only about 10 transverse rows of scales instead of the approximately 40 rows present in *Talpa*. In the type specimen of *Euroscaptor parvidens* (wrongly entered as a female in the original description) the length of the glans is 8 mm., width at middle about 5 mm., depth at middle about 4 mm., diameter of orifice about 2.5 mm. The scales, in their size, number, form and arrangement are essentially as in *E. klossi*.

Species.—In addition to the type species, *Euroscaptor klossi* (Thomas), whose range extends from northern and western Siam eastward to Thateng, southern Laos (Osgood Field Museum Nat. Hist., zool. ser., vol. 18, no. 10, p. 242, August 19, 1932) this genus includes the eastern Himalayan *E. micrura* (Hodgson), the southern Annamese *E. parvidens* (*Talpa parvidens* Miller, Journ. Mamm., vol. 21, no. 2, p. 203, May 14, 1940) the eastern Mongolian and western Chinese *E. longirostris* (A. Milne-Edwards) and the following large mole from western China:

3. Euroscaptor grandis, new species

Type.—Adult female (skin and skull), no. 255370, U. S. National Museum. Collected on Mount Omei, Szechuan, China, at an altitude of 5000 feet, in January, 1930, by D. C. Graham. Original number 370.

Diagnosis.—Resembling the Siamese *Euroscaptor klossi* (Thomas) but larger (greatest length of skull about 37 mm. instead of about 30–32 mm.; greatest breadth of braincase 17 mm. instead of 15 mm. or slightly less; mandible 24 mm. instead of 20–21 mm.; width of fore foot, dry, 15 mm. instead of about 12 mm.); color distinctly brownish, as in *E. micrura* (Hodgson). Differs from the Chinese *E. longirostris* in its large size and clavate tail.

External characters.—Externally this mole is at once distinguishable from *Euroscaptor klossi* by its large size and brownish color. The tail is as definitely clavate as in the Siamese species, thus differing conspicuously from the unmodified talpine tail of *E. longirostris*.

Skull and teeth.—Except for their greater size the skull and teeth differ slightly if at all from those of *Euroscaptor klossi*. The skull is about as long as that of *Talpa romana*, but its breadth, at whatever point may be selected for comparison, is somewhat less than in the large Italian mole, and the cheekteeth are noticeably smaller.

Measurements.—Head and body (skin) 150 mm.; tail, 9.6; longest hairs on tail, 14; fore foot, length 23.0, width, 15.0; hind foot, length, 18, width, 7. Skull: greatest length 37±; palatal length, 15.2; breadth of braincase, 17.0; postorbital constriction, 8.2; interorbital breadth, 7.0; breadth over roots of canines, 5.0; mandible, 24.6; maxillary toothrow (alveoli), 15.6; mandibular toothrow (alveoli), 14.4.

Specimens examined.—The type.

Remarks.—The Mount Omei mole differs from the smaller members of the genus *Euroscaptor* in much the same way that *Talpa romana* differs from *T. europaea*. Its large size and its very short, clavate tail (about half as long as the hind foot) distinguishes the animal sharply from its nearest geographical neighbor the widely distributed eastern Mongolian and western Chinese *E. longirostris*, whose known range I would now extend southward into northern Tonkin, French Indo China, on the strength of the two specimens from Chapa that Dr. Osgood recorded in 1932 as *Talpa klossi* (Field Mus. Nat. Hist., zool. ser., vol. 18, no. 18, p. 242, August 19, 1932). In each of these the tail is as long as the hind foot, its extremity with no enlargement.

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A MEMBER OF THE HYAENIDAE FROM THE UPPER PLIOCENE OF TEXAS

By R. A. Stirton and Wayne G. Christian

Members of the family Hyaenidae have not been recorded from America though numerous specimens were formerly thought to have had hyaenoid affinities. Additional material has shown that these belonged with other families and in the past score of years no one has seriously thought of the Hyaenidae as having been part of the America faunas.

Careful exploration and collecting under supervision of the late C. Stuart Johnston in the Panhandle of Texas has revealed many interesting records of late Tertiary Mammalia. Of especial interest is a right lower jaw that displays a profound resemblance to different members of the Hyaenidae. It seems most closely related to *Ictitherium hyaenoides* Zdansky from the Pliocene of China, though it is much more advanced than the Chinese species. Possibly it represents a continuation of that line in America.

Attention was directed to this locality by Mr. Floyd V. Studer of Amarillo who has shown an active interest in the Paleontology of the Panhandle region. Mr. Newton Harrell and Mr. R. H. Roach have very kindly permitted the West Texas State Teachers College to carry on extensive excavations in Cita Canyon.

Assistance in the collecting and preparation of this specimen was furnished by the personnel of Work Projects Administration Official Project No. 665-66-3-340. The manuscript was typed by Project No. 665-08-3-30, Unit A. I.

Ailuraena, new genus

Genotypic species: Ailuraena johnstoni gen. et sp. nov.

Etymology: αἴλουρος, cat; +αινα, a feminine ending. Species named for the late C. Stuart Johnston whose work in the Panhandle of Texas will remain a permanent contribution to Vertebrate Paleontology.

The characters of the genus are those of the type species described below.

Ailuraena johnstoni, new species

Holotype: Right lower jaw with I_{1-2} broken, I_3, C, P_{2-4} and M_1 in place, tip of coronoid and inner edge of condyle broken. Johnston, West Texas State Teachers College No. 2343.

Type Locality: North Cita Canyon, bed no. 4, Harrell Ranch, center of the west half of Sec. 164, Block 6, Randall County, Texas. The fossil bearing beds are of fluvial origin, semi-consolidated and approximately thirty feet thick. Stratification shows marked differences in color, texture and position. They rest unconformably on the Upper Triassic Dockum series and extend up to the level of the plains. They are considered by some authors as part of the Ogallala series. The stratigraphy will be described in greater detail in a report on the Cita Canyon fauna by Johnston.

Age: Upper Pliocene. Cita Canyon fauna-(Miller and Johnston 1937; Johnston 1938).

Diagnosis and Description.—Horizontal ramus with outward deflection in the region of P_2 and P_3; symphysis deep—48.0 mm.; lower edge of symphysis extends farther ven-

trally than outer edge of mandible opposite canine; lower outline of ramus strongly convex; greatest depth of ramus below M_1—45.0 mm.; single large mental foramen below anterior edge of P_2; tip of coronoid process and inner edge of condyle broken off; angle of deflection between coronoid and horizontal ramus about intermediate between that in *Felis* and *Ictitherium;* posterior outline of condyle not as conical as in *Felis* nor as irregular as in Recent hyaenas; masseteric fossa of moderate depth, not extended uninterruptedly up on the coronoid nor sharply outlined on its lower anterior border. Inferior masseteric ridge flattened posteriorly. Angular process partly broken off but heavy as in *Felis;* length from anterior alveolar edge of incisors to posterior edge of condyle—202 mm.

First and second incisors broken. I_3 with postero-external cusp—length 7.3 mm., width 6.4 mm. Enamel surface of canine strongly grooved and pitted by effects of grass roots but of normal size and shape, length 18.2 mm., width 14.5 mm., height 32.6 mm. (Measurements taken from edge of alveoli.)

First premolar absent. Premolars distinctly feloid. Cingulum distinct (though not heavy) on both sides of the premolars; outline of premolars can be appreciated best from the figures. A slight increase in size and prominence of the cusps is apparent from P_2 to P_4. P_2 double rooted; small anterior stylar cusp; single posterior cusp between cingulum and main central cusp; length 17.5 mm., width 9.2 mm., height 12.2 mm. P_3 with stronger backward inclination than in the other premolars but does not display any particular adaptation for crushing; smaller than P_4 but larger than P_2; length 22.4 mm., width 11.2 mm., height 13.8 mm. In both P_3 and P_4 the anterior cusps are distinct from the cingula. Measurements of P_4—length 25.9 mm. Width of cheek teeth was measured from edge of cingulum between the roots, height from base of cingulum between roots to tip of crown.

Carnassial slightly smaller than P_4; narrow posteriorly; talonid forms a distinct and well rounded cusp; cingulum on labial side and on anterior lingual corner, partly obliterated by wear; shallow groove on lingual side and upper third of paraconid blade; no trace of metaconid; anterior root about twice as large as posterior root. M_2 absent.

Comparisons.—This carnivore agrees with the members of the Felidae chiefly in the construction of its premolars; but even in the most primitive cats there is a strong reduction in the premolars not shown in the specimen at hand. It is true that Oligocene and most Miocene cats possess a single-cusped talonid but this is a primitive feature seldom observed even in early Pliocene species.

Ailuraena shows marked resemblance to the Hyaenidae but differs in some of its characters from all of the known genera. In *Crocuta* and *Hyaena* the horizontal ramus is not as deep, particularly in the anterior part, but the convexity in the lower outline is greater. The masseteric fossa is deeper and more distinctly outlined especially on the coronoid process. In the dentition these genera display a greater specialization in the premolars: P_2 shows more reduction in size and P_3 is well adapted for crushing. Though P_4 is not as specialized as P_3 it is not as aeluroid in appearance as in *Ailuraena.* Both of the Recent genera possess a single cusped talonid on M_1 as in the Cita Canyon specimen but *Hyaena* and some of the older species of *Crocuta* show a metaconid. A distinct resemblance however is shown to the hyaenas in the outward deflection and outline of the horizontal ramus and in the presence of a shallow groove on the lingual side and upper third of the paraconid blade.

Our comparisons with *Ictitherium, Lycyaena, Hyaenictis* and *Thalassictis* are taken from the carefully prepared and detailed descriptions and illustrations of Zdansky (1924) and Pilgrim (1931; 1932). The exact relationship of *Ailuraena* to these genera should be considered as tentative until more satisfactory comparisons can be made.

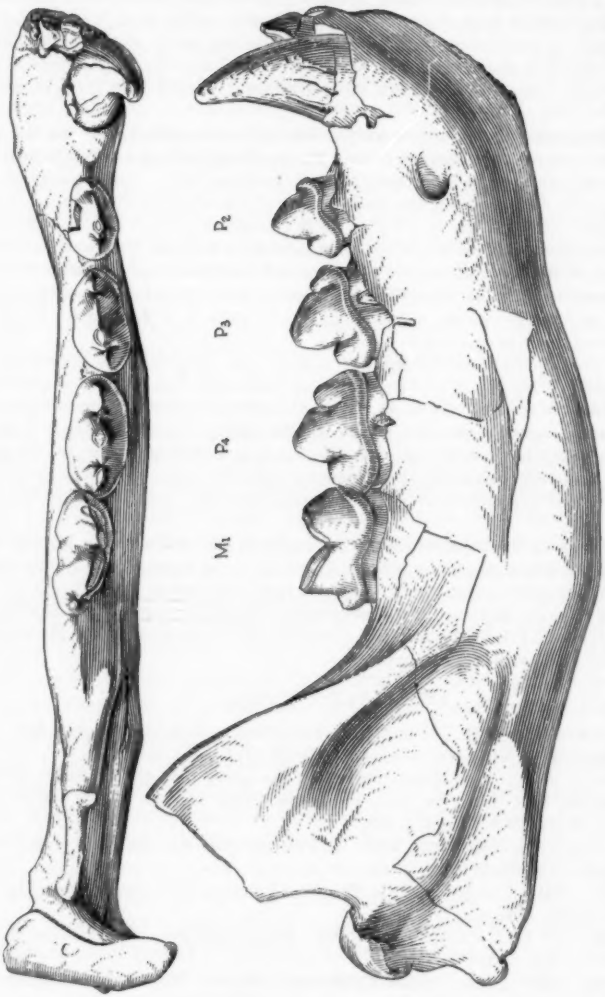

FIG. 1. *Ailuraena johnstoni* Stirton and Christian, n. gen. and n. sp., occlusal and lateral views of right lower jaw, type—Johnston, West Texas State Teachers College No. 2343. Cita Canyon fauna, Upper Pliocene, Randall County, Texas. Drawings by Owen J. Poe.

We conclude that the American genus shows as great if not greater resemblance to *Ictitherium hyaenoides* Zdansky than to any other known hyaenid.

Pilgrim (1931, p. 79) states that *Hyaenictis* "is only known by meager material, but seems to be in some ways intermediate between *Hyaena* and *Crocuta*, with indications of being more primitive than either, as by its retention of M_2 as in *Ictitherium*."

"The absence or small size of the anterior cusp in the lower premolars of *Thalassictis incerta* affords a distinction from *Ictitherium* and *Lycyaena*, . . ." (Pilgrim 1931, p. 80) offers some means of comparison with *Ailuraena*. Apparently M_2 is present in *Thalassictis*.

Both *Ictitherium* and *Lycyaena* are more primitive in several features than the mandible from Cita Canyon but there are certain profound resemblances to *Ictitherium* that seem to indicate relationship with that group of the Hyaenidae. In *Lycyaena* M_2 and P_1 are absent as in *Ailuraena* but the teeth display closer affinities with the Recent hyaenas. (Pilgrim (1931, p. 110) wrote that P_1 is represented by an almost obliterated alveolus in *Lycyaena chaeretis*.) Other characters tend to place *Lycyaena* out of the *Ailuraena* line of descent, these are: less aeluroid construction of premolars; lower border of ramus straight or very slightly concave; symphyseal region considerably thickened to carry large canine; a double mental foramen is present under P_1 and P_2 of *L. macrostoma* but it is single in *L. chaeretis*.

Ailuraena shows marked resemblance to a lower jaw of *Ictitherium hyaenoides* figured by Zdansky (1924, Taf. XVI, figs. 3–4). This is seen in the aeluroid construction of the premolars, backward tilted P_2, outward curvature of the lower jaw, convex outline of lower edge of horizontal ramus, similar shape and extension of masteric fossa, angle between horizontal and ascending rami, and shallow groove on the paraconid blade. In *Ictitherium wongi* the horizontal ramus is shallow but in both of these species there is a strong reduction of P_1 which may be in line with its loss in the later *Ailuraena*.

Ictitherium may be distinguished from *Ailuraena* in the presence of a M_2 and P_1; a metaconid on the trigonid and entoconid, hypoconid and hypoconulid on the lower carnassial. The outward curvature in the lower jaw also is not so pronounced.

Though we have no specimen of *Cryptoprocta* available for comparison the figures (Carlsson 1911, Taf. XIII, fig. 18) indicate a much closer resemblance of the Madagascar viverrid to the Felidae than to *Ailuraena*.

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HISTOLOGY OF THE SKIN OF A NORMALLY HAIRLESS RODENT

By Lorna W. Thigpen

Heterocephalus is a genus of hairless animals belonging to the African family of burrowing rodents Bathyergidae (Rüppel, 1845; Thomas, 1885a, 1885b; Brehm, 1914). Parona and Cattaneo (1893) made brief histological studies. Francaviglia (1896) made more extensive investigations, seeking especially for evidence of possible pathological causes of the hairlessness; he concluded the condition occurred normally, as in the Cetacea.

Because of its genus-specific hairlessness, it seemed worth while to compare the skin of *Heterocephalus* with those of mutant hairless animals. Among rodents the following genetically established hairless mutations have occurred: recessive hairlessness in the house mouse (Brooke, 1926; Snell, 1931); dominant hairlessness in the house mouse (Lebedinsky and Dauvart, 1927; Redlichs, 1937); two instances of recessive hairlessness each in the deer mouse (Sumner, 1924; Clark, 1939), the rat (Roberts, 1924; Wilder et al., 1932), and the rabbit (Kislovsky, 1928; Castle, 1933). The two cases in the deer mouse are very different, one being similar to the recessive hairless house mouse and rat, and the other structurally similar to the house mouse heterozygous for dominant hairlessness but unique in affecting only the postjuvenal pelage. The two mutants in the rat probably are identical, as suggested by Feldman (1935). In the rabbit, two histologically different conditions are found. Of these forms, the writer has made histological studies of the dominant and recessive hairless house mice, the hairless deer mouse reported by Sumner, the hairless rat described by Roberts, and the hairless ("naked") rabbit described by Kislovsky (David, 1932a). The "furless" rabbit (Castle) was examined histologically by Drapeau (1933). In general, four different conditions are represented in which 1) the first hair coat appears normal but is lost at weaning time; subsequently, partial hair regenerations take place and some follicles form large numbers of cysts which render the skin thick and opaque, and finally cause a folding of the skin (recessive hairless house mouse, deer mouse (Sumner) and rat); 2) imperfectly keratinized hairs are formed which break off (dominant hairless house mouse, recessive "postjuvenal nude" deer mouse); 3) the number of follicles is less than normal (naked rabbit); and 4) an excessive keratinization within the hair canals prevents the normal eruption of the underfur hairs (furless rabbit). Among nonrodents, Mohr and Wriedt (1928) reported a recessive hairlessness in cattle in which areas of retarded follicles were found next to areas without follicles. Prinzhorn (1921) found that hairless dogs showed a varied condition of hair development ranging from primitive anlagen to well developed hairs; hairlessness in the dog is a dominant trait, as shown by several investigators. Hairless swine show a reduction in the number of hairs, the heterozygote

showing a condition intermediate between that of the normal and homozygote (Roberts and Carrol, 1931; David, 1932b). Landauer (1926, 1929) listed additional cases of hairlessness.

MATERIALS AND METHODS

Through the courtesy of Dr. James Anderson of Naivasha, Kenya, Africa, Dr. Landauer was able to secure eleven formalin preserved specimens of *Heterocephalus;* the writer wishes to express appreciation to both Dr. Anderson and Dr. Landauer for this material. These animals range in size from 13.3 cm. to 20.6 cm. (in total length), and all probably belong to the same species, the smaller being immature individuals. This is suggested not only by a general similarity, but also by a comparison of the histological structure of the skin and by the degree of hardness of the teeth and bones.

Samples of skin from six specimens were examined histologically and included mid-dorsal, mid-ventral, anterior-ventral (between forelegs), mouth, side and top of head, foot and tail regions. Serial sections were stained with haem-alum and eosin. Sections were also prepared from regions showing skin parasites (anterior to fore and hind limbs, ventrally). Pieces of skin from various body regions containing one or more follicles and hand-cut sections were stained with Sudan III and cleared in glycerine for a study of the fat cells and fat deposits. The skin was removed from an entire half of two individuals, cleared in cedar oil and examined *in toto*.

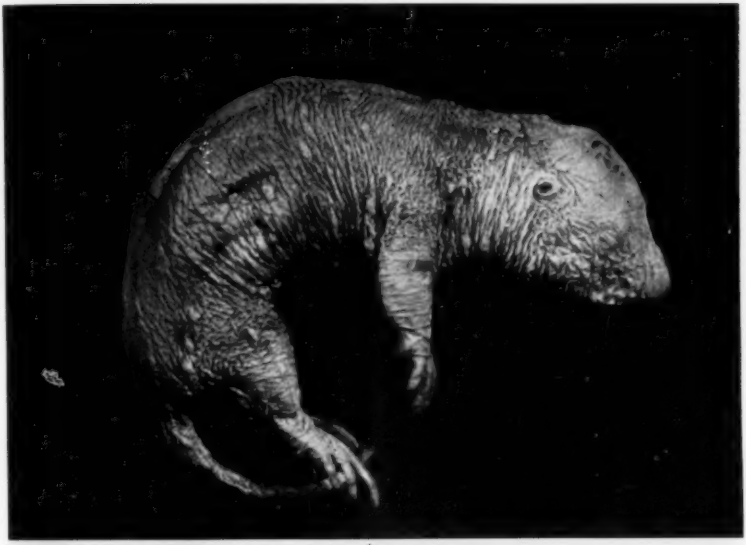
RESULTS

All specimens show a wrinkled, warty skin, whitish-yellowish in appearance except on the dorsum, which is slightly bluish because of pigment cells within the skin. The eyes are small and difficult to locate. The ears are filled with tiny hairs; small hairs are also located around the urinogenital region. Inconspicuous unpigmented hairs are scattered over the entire body; they can be seen around the edge of the animal in figure 1. All hairs are non-medullated and bristle-like in structure. They are most numerous around the mouth, where they range in length from 2 to 11 mm. On the body they are about 5 to 7 mm. long; on the tail from 1 cm. at the base to 2 to 3 mm. at the tip. Hairs of the fringe (always a single row of follicles) on the feet are from 1 to 3 mm. long. On the outer fringe of the right foot of one specimen approximately 30 follicles are present over a distance of about one centimeter. About 80 follicles are on the body proper (excluding head, appendages and genital region) of the specimen in figure 1. Except for the feet, the mouth region, the inside of the ears and the urinogenital region, hairs are sparsely placed and arise from elevated wart-like follicles. In the excepted regions, the follicles tend to be close together and are not raised. All follicles contain one or two hairs, except for some of the follicles on the outer sides of the last three toes. Here hairs may be worn down to the level of the skin or missing entirely. This wear may even destroy the follicles, as indicated by four pieces of skin (one sectioned, three stained and examined *in toto*) which show no signs of follicles within the skin at places where hairs are found in other specimens.

Definite direction of the hairs is evident. The body hairs tend to stand perpendicularly with a slight posterior trend, but may be turned in any direction, even forward, of the skin folds. Some hairs are slightly curved. Of two hairs in a given follicle, one is always longer than the other; apparently the club hair is shed before the new hair has attained its full length.

Teeth and nails appear normal.

In accordance with the gross appearance, sections show that the skin is of uneven thickness (figs. 2, 3, 4), the outer surface exhibiting a wave-like form. Large folds show



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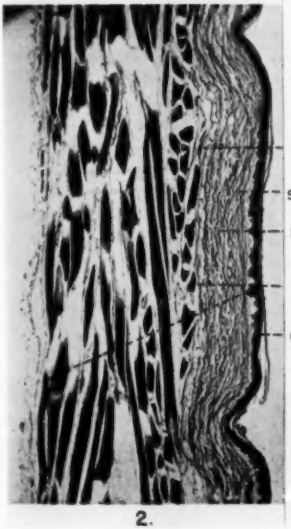

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FIG. 1. Photograph of female *Heterocephalus* 20 cm. long

FIG. 2. Skin from dorsum. ep., epidermis; str. pap., stratum papillare; str. ret., stratum reticulare; f. c., fat cells; s. m., skin musculature.

FIG. 3. Skin from tail showing tangential section of follicle and fat body. h., hair; s. gl., sebaceous gland; b. s., blood sinus; f. b., fat body.

smaller folds, especially in the more wrinkled regions (fig. 4d). Between the folds the skin gives the impression of having been pressed from above, cellular elements and fibers being flattened and compacted. Measurements (in microns) of the skin, including the stratum corneum, of a large and a small animal are given in the following table. Figures in parentheses represent measurements without the skin musculature (panniculus carnosus).

	DORSUM		VENTRUM	
	Thick	Thin	Thick	Thin
Large	900 (343)	786 (286)	1260	243
Small	414 (257)	257 (129)	357	90

Great variation in structure and thickness is seen in the epidermis and corium. A thick epidermis, of papillated structure (fig. 4a, b) is found on the mid-dorsum and on the upper lip; a thin, non-papillated epidermis on the ventral and frontal regions; while a non-papillated epidermis of intermediate thickness occurs on the tail and hind foot (thick on toes where hairs are worn off). Everywhere, in papillated and non-papillated places, the epidermis in the thin places (that is, between folds) consists of a layer of two or three undifferentiated flattened cells. In these thin regions the epidermis is always less differentiated than in adjacent thick regions (4 to 8 cells). The largest epidermal papillae are found on the upper lip and are from 16 to 18 cells deep, measuring about 140 micra. A stratum granulosum consisting of a single row of interrupted cells is present in all regions except the ventrum. The stratum corneum is rather thin; there are about 6 to 8 lamellated layers in the thickest places. In some regions, especially the head, the stratum corneum forms half pearls which extend down into the epidermis (fig. 4a, b).

The corium is very variable in thickness. Two layers, the stratum papillare and stratum reticulare, are clearly present in some regions, especially where the epidermis is papillated. The upper, stratum papillare, is characterized by its finer fibers, which tend to run parallel with the epidermis. The stratum papillare is not sharply divided from the lower, stratum reticulare, which consists of heavier fibers and forms most of the corium. Where the skin is thin, fibers of the stratum reticulare also run parallel with the surface of the skin, but in the thicker regions the parallel arrangement tends to disappear. The increased mass of the thicker places (folds) largely results from an increase in the stratum reticulare.

Skin from the back contains dark brown or black pigment cells. Usually, but not invariably, they are located near blood vessels. Pigment cells are much less frequent on the ventrum and contain a light brown or yellowish pigment. In the region of the mouth, bands of striated muscle are present in the corium; these are described in detail by Francaviglia. In general, the corium is well supplied with nerves and blood vessels. Except in the mouth region, where they are lacking, fat cells are rather numerous but scattered; while usually present in the neighborhood of blood vessels, they may be located elsewhere. In skin from the top of the head there are tiny fat cells between the epidermis and the stratum papillare which appear as a distinct red layer in Sudan III stained sections; larger fat cells are scattered elsewhere in the corium.

Usually the subcutis (the layer of delicate connective tissue lying between the corium and the body or the panniculus carnosus, where present) is not evident except surrounding blood vessels and nerves. On skin from the ventrum, however, the subcutis is noticeable as it extends into the lower portion of the large folds (fig. 4d). *Hetero-*

cephalus lacks a typical fat layer in the subcutis, such as is found in mice during hair growths (David 1932a, p. 693); Redlichs, pp. 511–12). (It is obvious that the "stratum reticulare" which Redlichs describes in the house mouse is the fat layer of the subcutis.) In all the regions sectioned, however, with the exception of the mouth, each individual follicle below the sebaceous glands is surrounded by a delimited fat region (figs. 3, 4c). This is best seen in dissections made by use of a binocular of whole pieces of skin stained with Sudan III. The fat region consists of two lobes, one on each side of the follicle, which lap so closely together that their boundaries are not conspicuous in sections. These fat bodies extend to, or nearly to, the end of the follicle in its growing stage.

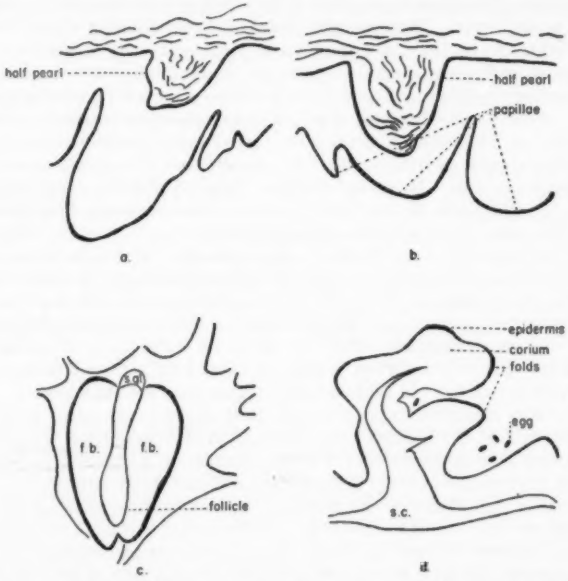

FIG. 4. Camera lucida diagrams. *a* Epidermis from upper lip showing papilla and half-pearl. *b* Same from frontal region. *c* Sudan III preparation showing follicle, fat bodies, and surrounding area of less dense fat with blood vessels. *d* Skin from ventrum showing excessive folding, pocket like formations containing parasite eggs, and the subcutis (s. c.) extending into folds. See text.

Their size appears to remain relatively constant during the cycles of hair growth. The follicles on the foot are so close together that the surrounding fat bodies are brought nearer together and in some cases give the impression of a continuous though somewhat uneven layer of fat.

Nerves and blood vessels going to the follicles pass through the fat bodies; in fact, the fat bodies give the impression of having been laid down around the vessels. By means of small amounts of fat (red in Sudan III preparations) which follow along the blood vessels, the latter can be traced readily from the follicle to larger vessels, and often, to the subcutaneous fat deposits between the skin and body proper.

The hair follicles are particularly large, their length exceeding the thickness of the skin in adjacent hairless places. Since they tend to stand perpendicularly, the skin shows conspicuous local thickenings, obviously the "warts" of earlier descriptions. These hair-follicle warts are largely filled with the fat bodies; the corium and epidermis show no particular change in mass and are simply elevated (Fig. 3). In spite of the increase in thickness caused by this wart-like formation, the skin may still be too thin for the follicle in its growing stage, and in such instances the follicle curves and/or pushes against the underlying tissue. In one instance, the skin musculature is pierced by a growing follicle. Sebaceous glands seem relatively small, but are well developed. The usual follicle layers are found. Except on the feet, blood sinuses are present within the connective tissue layer of the follicle and in some instances add enormously to the size of the latter. They resemble those of the vibrissae of the rat described by Vincent (1913). While they may function to increase tactile sensitivity and not as erectile organs, as Vincent suggests for the rat, it seems somewhat more possible that they may have an erectile function in these specimens because the usual arrector muscle is lacking. (Francaviglia, however, reported arrector muscles in *Heterocephalus glaber*.)

Comparison of follicles in different body regions and in corresponding areas of the two body sides show some irregularity, but suggests that hair growth occurs in limited regions at any one time. In nearly all cases observed, if hairs are growing in given follicles on the right side, they are also growing in the corresponding follicles on the left. The hairs may be in different stages of development, however. This condition seems to be between that found in the house mouse (Dry 1925) and in man (Danforth 1939), in which great uniformity and a high degree of autonomy, respectively, exist.

Because of the division of the corium of *Heterocephalus* into a stratum papillare and a stratum reticulare, normal and hairless skins of other rodents (house mouse, deer mouse and rat) were examined. Only the rat shows indications of two layers in the corium and here the differentiation is slight and not constant. No division is seen in one, seven and fifteen day old rabbits; older stages were not examined.

As observed by Maximow (p. 411), human scalp shows considerable variation in the amount of fat around the follicles. An examination of 30 samples of scalp shows some in which the fat is so extensive that it forms a definite and conspicuous layer, broken by inconspicuous strands of fibers going downward from the stratum reticulare; except for these strands, this type is rather similar in gross structure to mouse skin during a period of hair growth. In other samples of scalp, the fat is limited to just around the follicles, large masses of fibers (in contrast to the strands just mentioned) filling the intervening areas; this type is superficially similar to the skin of *Heterocephalus*. In the scalp material examined, as in *Heterocephalus*, there appears to be no association, at least of a conspicuous nature, between hair growth and the amount of fat surrounding a follicle. On the other hand, the deer mouse and the rat, like the house mouse, show a striking increase and decrease of the fat layer of the subcutis during periods of hair growth and non-growth, respectively.

DISCUSSION

Hairlessness in *Heterocephalus* is caused by a lack of follicles, except for those of the scattered sensory hairs, and represents a type different from the hereditary ones previously described. As in these cases, however, the term hypotrichosis is more accurate than the commonly used hairlessness.

The skin folds of *Heterocephalus* are superficially rather like those found in the mutant hairless rodents both in appearance and in distribution. As observed among artificially depilated as well as in hairless mice, a thick, loose skin probably is the chief requisite for the formation of skin folds among mammals (David 1934). The larger

specimens of *Heterocephalus* show a higher degree of folding than do the smaller ones, suggesting that the amount of folding increases with age. Unfortunately, newborn animals were not available, and hence it is impossible to know whether or not the young are wrinkled at birth. The thickness of the skin, whether present at birth, or, as seems more likely, developed later, is caused by factors different from those causing the thick skin found in the recessive hairless house mouse, deer mouse, and rat. In the mutants just named, the thickness of the skin is due to cysts formed by the follicles, while in *Heterocephalus* the thickness is due to growth in localized areas of the epidermis and corium through the skin. A comparison of adjacent thick and thin regions suggests that a proliferation of the epidermis may be primarily responsible for the increase in thickness because of areas in which the corium appears irregular and stretched. The presence of parasite eggs and embryos adhering to the surface of the epidermis in various regions (adult parasites are found within the skin only in definite locations), suggest the possibility that they may stimulate the epidermis; this possibility is strengthened by the fact that, in a few instances, the epidermis shows an increase in thickness at the site of attachment of young parasites.

Well developed subcutaneous fat deposits between the skin and body proper indicate that these animals are well nourished and do not suffer particularly because of their lack of hair. Adult recessive hairless house mice, on the contrary, show very little little subcutaneous fat and the females are sterile under ordinary conditions. Reared at relatively high temperature, however, the females are fertile. It is not certain, of course, that *Heterocephalus* suffers from the lack of a fur coat, but if so, the tropical climate in which it lives would favor its survival.

The presence of arrector muscles (musculi arrectores pilorum) as reported by Franceaviglia and their absence in specimens of the present study, suggests a species difference between the two.

SUMMARY

The hypotrichosis which normally occurs in *Heterocephalus* is characterized by a lack of follicles except those of the sensory hairs. Follicles on the body are elevated and especially large; they are obviously the warts of earlier descriptions. The epidermis varies greatly in thickness, from 2 to 3 undifferentiated, flat cells in the depressions between the skin folds to 16 to 18 more active appearing cells in the thicker, papillated regions on the folds. The corium also varies greatly in thickness and is divided into a stratum reticulare and a stratum papillare. The usual fat layer of the subcutis is not present; instead, individual follicles are surrounded by a pair of fat bodies, and scattered fat cells are present within the corium. The arrector muscle of the follicle is lacking; large blood sinuses within the connective tissue sheath may possibly function also as an erectile organ. The wrinkling of the skin probably is caused by an increased thickening due to localized growth of the epidermis and corium.

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Storrs Agricultural Experiment Station, Storrs, Connecticut.

GENERAL NOTES

A DELAWARE RECORD OF ALBINISM IN BLARINA

When I recorded (Jour. Mamm., vol. 21, no. 1, p. 89) an albinistic Pennsylvania specimen of *Blarina brevicauda talpoides* in the collection of the Academy of Natural Sciences of Philadelphia, I overlooked an albinistic specimen from Delaware. This is an alcoholic specimen numbered 12321 in the Academy's mammal collection. It is a female collected by W. T. Massey at Smyrna, Kent County, Delaware on November 16, 1906.

After thirty-four years in alcohol, it is difficult to determine whether or not the eyes are pigmented; but the shrew is pure white, and the skin of the feet, tail and nose-pad is entirely unpigmented. The claws are colorless. It is interesting to note that the teeth of both Academy albinos are not affected by the lack of pigment in the skin and hair, but are tipped with dark chestnut in the normal manner.

It would seem, now that we have records of albinism in the genus *Blarina* from Indiana, New York, Connecticut, Pennsylvania and Delaware, and from such varied environments as prairie, mountain and coastal plain, that this condition is not as uncommon in this shrew as was once believed.—Frederick A. Ulmer, Jr., *Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania.*

THE MOLT OF BLARINA BREVICAUDA

In a previous paper (Ohio Journal Science, vol. 31, no. 2, pp. 97–106) I referred to the molt of *Blarina* occurring without regard to season; specimens taken in December and June alike showed molt. It was observed that the most pronounced change from winter to summer pelage was best marked in May and June, while specimens secured in October or November occasionally show some indication of change to a winter pelage.

During the past ten years many additional specimens have been examined, a total of more than 1000 adult shrews in the flesh being available for a study of the pelage changes. These were all taken in New York. With this large number, it is quite remarkable that only 25 molting individuals have been secured. Townsend (Roosevelt Wild Life Annals, vol. 4, no. 1, pp. 1–120, 1935) collected 742 blarinas from June to August in central New York over a five year period, and while many of these were obviously young shrews, still he records but a single male in molt, on July 10, 1932. These records imply that the molt in this shrew is a very rapid affair and must be consummated in a very few days, else a much higher percentage of the trapped animals would show the molt in progress. The complete molt in two captives occupied six weeks; but it is noteworthy that in both instances most of the fur was renewed in five days, the old hairs of the rump only persisting for the longer period. Inasmuch as most shrews that are wild caught during a molt usually exhibit the change on the head and rump, it may have been the influence of captivity that allowed the persistence of the fur in these regions over such a long period. In this connection, it should be noted that *Sorex araneus*, at least in captivity, molts in a very short time. Wilcke (Zeitsch. f. Säugetierkunde, vol. 12, no. 3, pp. 332–335) observed that an animal collected in early April shed its winter coat almost completely in two days, while an immature shrew, caught in early October, immediately shed its summer fur. I gather from this that the molt did not take more than a few days.

For this study, not less than 30 shrews were available for every month in the year. One December specimen had completed the molt except for a small area at the base of the tail. No January or February specimens exhibit a molt. Five March shrews show the progress of the change in pelage. An adult male trapped on March 23 has a sizeable oblong tract of new fur on the back, while most of the winter fur on the venter

has been replaced by the summer pelage. An adult male secured on March 25 has new fur over the entire body except for small patches on the lumbar region and base of tail respectively. A large female collected on March 31 has the new summer pelage on the head and shoulders, much new fur on the belly and a small patch about the size of a pea on the rump. An adult female taken on April 6, in contrast to the last specimen mentioned has new fur over the entire dorsal area except on the head and a small area on the rump. Most of the dorsum of a female taken May 7 has acquired the summer pelage; a small hour glass shaped area and the head alone persisting in winter pelage. An adult female collected on June 2 has new fur on the dorsal part of the head alone, the rest of the pelage being winter fur. A male taken on June 5 has new summer fur on the entire head, extending ventrally to include the base of the fore legs, a small area about the right side gland, and a small patch at the base of the tail. A female taken on June 21 has a narrow patch of new fur along the mid ventral line, this patch bifurcating as it approaches the fore limbs. Elsewhere the winter fur persists. A specimen collected June 16 has the head, a narrow strip between the shoulders, and a broader area along the back almost to the rump in summer pelage. Three adult males showing the molt were taken on June 25. One has new fur over the entire fore part of the body, this area extending in a narrow band past the middle of the body and a small patch of new fur on the chest. The other has the new summer fur on the head extending caudad midway between the shoulders, a small patch of new fur in the middle of the back and another small patch just behind this. The third has sharply defined areas of summer pelage on the head, shoulders and a broad band just in front of the rump. An adult male collected on June 27 had acquired new fur on the head only, this patch being rather sharply marked off from the rest of the winter pelage by a wavy line on the neck. An old shrew collected on June 29 retains only a few scattered winter hairs on the rump. Three specimens showing the progress of the molt were obtained on July 21. An adult male has an oval patch of old fur nearly an inch in length persisting on the venter, while a few scattered winter hairs remain on the rump. The remaining two have only a small area of winter fur about the rump. An adult male collected on August 4 at Point au Baril, Ontario, has only the head and a bean shaped patch on the left flank in summer pelage.

The only immature shrew that shows a molt was taken on August 14. Incipient molt on its head has begun; the paler fur of this region is in marked contrast to the darker fur characteristic of immature animals.

The fall molt is notable only for the paucity of specimens which show the pelage change. An adult male taken on October 6 has a broad irregular patch of new fur appearing over the hips. Elsewhere the summer fur persists.

From these records, it is apparent that the molt does not proceed in any conventional manner. The majority of specimens show molt in progress on the head and about the rump, in these regions the fur may be lost first or may persist longer than the rest of the pelage. I am of the opinion that, under natural conditions, the entire winter pelage is replaced by the summer fur in a matter of a few days. This can only be ascertained by collecting live individuals, marking them, and retrapping these marked shrews repeatedly. This should not be a difficult task for a favorably located observer. It would require only that the traps be visited often, for shrews are notoriously short-lived when confined in traps.—W. J. Hamilton, Jr., *Cornell University, Ithaca, New York.*

TROUT AND CRAYFISH EATEN BY COYOTES

In the winter of 1928–29, in Yellowstone National Park, I observed a coyote in the act of catching crayfish. The coyote was viewed from a considerable distance, with the aid of a pair of binoculars, in the shallow and warm waters of Pole Cat Creek. Slowly

wading along near the bank of the stream the animal suddenly stopped and submerged its muzzle in the water. It then raised its head with some object in its mouth on which it was fervently chewing. This maneuver was repeated several times. The animal at least twice jumped upon the bank of the stream and there consumed its catch. On examination of the site, I found remains of crayfish. At this time, as well as quite frequently later, I found parts of crayfish in coyote droppings.

During the past winter, while on patrols along the Yellowstone River near the northern boundary of Yellowstone National Park, I frequently saw coyotes sitting near the open holes in the ice; but was unable to determine what attracted their attention. However, on February 4, 1940, in company with CCC Enrollee Sloan, I observed a coyote standing in the Gardiner River (tributary to the Yellowstone) holding in his mouth a large object which we at first believed to be a duck. The coyote when first seen was standing in water about four inches deep. Then he started backing toward the bank of the stream, shaking the object in his mouth. In order to make a more careful observation, I walked around to the opposite side of the river without disturbing the animal and when within a distance of about 40 feet I determined that the large object in the coyote's mouth was a fish. On reaching the stream bank the coyote fed upon the fish for several minutes; then, noticing my approach, he started to run away with his catch but dropped it in a short distance.

The fish was a Loch Leven trout weighing three to four pounds. It had been consumed from the head back to just above the dorsal fin. Fang marks on the remaining portion were made parallel to the backbone and indicated that the fish had been caught by the coyote in the shallow water near this location. The healthy appearance of the fish and copious amount of fresh blood on the rocks and snow left little doubt that the fish had been alive when caught.—Rudolf L. Grimm, *Yellowstone National Park, National Park Service, Yellowstone Park, Wyoming.*

TWO RECENT MAMMAL RECORDS FROM ALLEGAN COUNTY, MICHIGAN

In the course of management studies at the Swan Creek Wildlife Experiment Station I secured two mammal records that appear to be the first for Allegan County in recent years.

Urocyon cinereoargenteus cinereoargenteus.—In the early days of settlement the gray fox was common in Michigan. Early in this century, however, it was being extensively replaced in farm communities by the red fox. Few of the grays were heard of after 1912. The last reported specimen was taken in Boyne Valley Township, Charlevoix County, by J. H. Stephenson in 1922 (Dice, Univ. Michigan Mus. Zool. Occ. Papers, no. 159, pp. 19–20). Previous to this the last report had been in 1914.

On February 2, 1939 an adult female gray fox was shot in Section 4, Township 2 North, Range 13 West, Allegan County. The animal had been run with dogs several times during the winter and was finally taken by Clarence Maskey of Allegan. I secured the specimen and preserved the skin and skull. They are now in the collection of the Swan Creek Wildlife Experiment Station. The measurements were as follows: Total length, 988; tail, 372; hind foot, 142; ear, 75; it weighed 4460 grams. The animal was in excellent flesh but not fat.

Mustela rixosa allegheniensis.—Until 1932 the least weasel was unreported in Michigan. A specimen was taken in that year (Dearborn, Jour. Mamm. vol. 13, p. 277) and another record was obtained in 1936 (Hatt, Jour. Mamm. vol. 17, pp. 414–415). There have been several other records since then. Specimens which probably represent the first for Allegan County were captured on July 29, 1939 on the Swan Creek farm (Sec. 5, T2N, R14W, Allegan County, Michigan). L. J. Acton was plowing when he noticed six small weasels tumbling about in the furrow. One, an adult, escaped but he suc-

ceeded in catching five young animals which had apparently been plowed out of a burrow in the sod.

These juveniles were brought to the laboratory and put in a cage. It soon became apparent that if they were left together some would be killed, for they fought savagely. Even when a mouse was placed in the cage they paid no attention to it in their preoccupation with one another. Four of the weasels were placed in separate cages and the fifth made into a skin. In what was presumably the full litter of five, three were females and two were males. The measurements of the male that was skinned on July 31 were as follows: Total length, 166; tail, 30; hind foot, 20; ear, 12.3; it weighed 40.5 grams.

The four other weasels were fed exclusively on live mice and kept in captivity until September when they appeared to be full grown. The animals were then prepared as skins. During this period a record was kept of the number of mice consumed by each weasel and the captives were weighed periodically. Most of the mice were house mice but a few *Microtus pennsylvanicus* were used when the supply of the house mice ran short. The table gives weights and the total number of mice consumed.

NO.	SEX	WEIGHTS IN GRAMS								TOTAL MICE EATEN
		August 8	August 14	August 21	August 28	September 4	September 20	September 21	September 26	
1	♀	41	45	47	45	49	49			60
2	♀	44	49	44	49	50			50	64
3	♀	47	57	58	56	58		62		65
4	♂	46	59	55	62	61	62.5			63

When first captured these animals were apparently unaccustomed to handling live prey. It took them approximately two minutes to subdue a house mouse. By September they were able to kill an average-size *Microtus* in 30 seconds. The point of attack was the back of the skull which they bit with a raking motion of the jaws. On one occasion an exceptionally large field mouse was placed in the cage with one of the weasels. The weasel and mouse appeared to become friendly and even slept rolled up together in a wad of cotton. For several days the weasel quickly killed other mice that were placed in the cage and the field mouse even helped, at times, to eat them. On the fourth day, however, the weasel suddenly siezed the mouse and dispatched it.

One of these specimens is in the collection at the Swan Creek Wildlife Experiment Station at Allegan; two are in the Department of Conservation collection at Lansing, and two are in the collection of the University of Michigan Museum of Zoology at Ann Arbor.—DURWARD L. ALLEN, *Game Division, Department of Conservation, Lansing, Michigan.*

A SOURCE OF MEAT FOR DIETS OF WILD RODENTS

Through their destruction of both eggs and young of birds, as well as through occasional killing of small mammals, the meat-eating proclivites of our tree squirrels are well established. The common eastern chipmunk has been known to kill frogs, snakes (Harriot 1940), birds (Crandall 1936) and even small mammals (Terres 1937). Hamilton 1939) implies that the smaller ground squirrels and prairie dogs are possibly also inclined to vary their herbivorous diet by occasionally eating meat. While his materials are usually well documented, in this case he cites no references. This fact has led me to put on record some of my recent observations.

During June of 1938 and, again in late August and early September of 1939, I made two extensive automobile trips through the region west of the Mississippi. My interest in the number of animals killed by automobiles led me to make additional observations on what becomes of these bodies crushed on the road. I know that many of the bodies are picked up by crows, magpies, and other birds, and also by carnivorous mammals. In hot dry areas the bodies may become completely dessicated before the meat has had time to decay. Thus both fresh and dried flesh is available as food for other animals.

When a black-tailed prairie dog *Cynomys ludovicianus*, was seen trying to drag from the road a freshly killed animal of its own kind, my first thought was that one of a pair had been killed and the mate was trying to drag it back to the burrow. Continued observations revealed that many other prairie dogs ranging in sizes and ages from youth to old age were picking up pieces of bodies in conditions varying from freshly killed material to thoroughly dried meat. The animals either fed on this meat on the road or dragged it off toward their burrows. This action was seen scores of times and it was also participated in by different species of ground squirrels. The live animals were often so reluctant to leave a carcass that they risked being struck by the car, or ran but a few feet off the road and almost immediately returned to their feast.

Early in September of 1939, while traveling through southern Oregon, I saw a dead tree squirrel in the road a short distance ahead. It seemed a particularly large mass of fur and as the car neared it, I discovered a live squirrel of the same species tugging at the meat of the dead one. The live squirrel did not leave the dead one until the car was almost abreast of the spot, then it ran off the road and up a tree.

Why are the dead carcasses so attractive to these animals? Is the attraction the salt or the liquid in the blood and flesh? Is it merely a desire for a variation in diet? That it could be lack of food seems hardly probable for in no case did the usual vegetable food of the species seem to be lacking or even particularly scarce.

Is this a habit which is developing to a greater extent in the dry areas of the West or is it a more wide spread phenomenon in other regions than is now realized? Further observations and some experimentation might disclose some very interesting and valuable information along this line.

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—Albert R. Shadle, *Biology Department, University of Buffalo, Buffalo, New York.*

TWO CASES OF ABNORMAL COLORATION IN MAMMALS

Two cases of abnormal coloration in wild populations of small mammals have come to my attention.

One adult female among 144 four-toed kangaroo-rats (*Dipodomys merriami ambiguus*) trapped about 3 miles south of Alamogordo, Otero County, New Mexico, is light neutral gray on the dorsal surface. This gray grades into pale cream on the sides. The underfur is light slate gray. This kangaroo-rat is much paler throughout than any of the 143 others. Ordinarily the upperparts are dark buff, with a considerable amount of blackish in the dorsal area.

One young adult female of 6 pocket-mice (*Perognathus fasciatus fasciatus*) collected by Lee R. Dice, 9 miles east of Bismarck, Burleigh County, North Dakota, is strongly melanistic. The 5 others are grayish olivaceous, the normal color of this form. The aberrant individual is blackish over most of the dorsal surface. Principal exceptions

are the white tops of the feet and a few cream colored hairs on the outside of the ears. Most of the hairs on the outside of the ears are black. The post-auricular spot is reduced in size. The dorsal surface of the tail is blackish instead of gray. Ventrally, the blackish extends across the abdominal region. Here, most of the hairs are blackish to the tips. In the thoracic region, some of the hairs are entirely white, but most are dark at the base and white at the tip. One of the 5 dorsally normal colored specimens is quite similar in ventral coloration to the melanistic individual. An adult male of the same species from 7 miles west of Jamestown, Stutsman County, North Dakota, is slightly melanistic. It is not as dark dorsally as the melanistic individual from Bismarck. Ventrally there are less dark-based hairs in the thoracic region. One young adult female among 5 specimens from Steele, Kidder County, North Dakota, shows a slight darkening above. Ventrally it is similar to the melanistic specimen from Jamestown. One of the 5 specimens that have normal dorsal coloration is dark ventrally, like the melanistic individuals. These color variants give an indication of the materials that are available for the operation of natural selection. W. Frank Blair, *Laboratory of Vertebrate Genetics, University of Michigan, Ann Arbor, Michigan.*

WINTER KILL IN BEAVER

On May 12, 1940, L. J. Coughlin, wildlife specialist of the U. S. Forest Service, asked me to investigate the cause of death of some beaver that had been found dead on a small tributary of West Beaver Creek in the Medicine Bow National Forest. The next day I visited the place in company with Coughlin and the deputy game warden, William Lakanen. We found six dead beaver, five in a larger pond in which was a fair-sized lodge, one in a smaller pond where there was a small lodge. All were floating in cold water, were in the same state of preservation, and apparently all had died at about the same time, probably during the winter. Externally, the skin was beginning to soften, more so on the upper side, where hair could be pulled out rather easily. Internally, all organs were in a surprisingly fair state of preservation. No evidence of tularaemia or any other disease was observed. The spleen showed some evidence of deterioration. The lungs appeared most affected and were gangrenous in spots. Guinea pigs, inoculated with an emulsion of the spleen, gave no symptoms of tularaemia or other disease.

A consideration of the aetiological factors involved led to the conclusion that these beaver probably died under the ice from suffocation. The circumstances leading to this conclusion were as follows: All died at different places in the ponds at about the same time. There were no survivors. There was no evidence of disease. The ponds are shallow, with not more than 3 or 4 feet of water at their deepest parts. The elevation is about 9000 feet. Very little if any water runs through these ponds in mid-winter. According to Forest reports the snowfall, which usually covers beaver ponds in this area to considerable depth, was very light last winter. Under these circumstances the ponds would freeze practically solid. Food below the one foot level was conspicuous by its absence. Winter kill, probably by suffocation, appears to be the only satisfactory explanation.—John W. Scott, *Department of Zoology, University of Wyoming, Laramie, Wyoming.*

FIVE COTTONTAIL RABBITS UP A TREE

Recent literature contains numerous references to groundhogs, foxes, and other terrestrial animals seen in trees; but the cottontail rabbit is not mentioned among them.

On May 17, 1939, while climbing an old yellow willow (*Salix*) to photograph the nest of a mourning dove (*Zenaidura macroura carolinensis*) we found an interesting mammal nest. This willow tree stands 210 feet from the bank of the east branch of the Niagara River on the edge of a low, level, wet area on Grand Island, New York. It is a huge

specimen which measured 14 feet, 6 inches in circumference. As is common with very old trees of the species, there were many dead and broken limbs in its crown; there also were quantities of both dead twigs and growing sprouts from adventitious buds along the bole. Instead of a straight, upright trunk, the tree had an inclination of 48 degrees from perpendicular. Where the three main limbs branched from the short bole, there was a broad crotch where bunches of short sprouts had aided in accumulating a mass of dead twigs, small branches, leaves, and the like, several inches deep.

One man had climbed to the nest of the mourning dove about twenty feet up on the tree, and two of us had only reached the crotch of the first large limbs, nine and one-half feet above the ground, when a sharp cry from a small mammal was heard, coming apparently from this lodged dead material on which one of us stood. Stepping quickly to one side, the senior author began to move the dead twigs and soon uncovered a ball of dried leaves of bluegrass. This ball of grass was lined with rabbit fur, and further examination revealed in it five young cottontails (*Sylvilagus floridanus mearnsi*) about six or seven days old. The nest was buried in the accumulated twigs and bark until the fur and grass were completely hidden. Because of the forty-eight degree inclination of the bole of the tree, every time the adult rabbit carried material to the nest or returned to nurse her young she had to travel up the trunk of the tree to a point twelve and one-half feet from the ground.

While it is rather common for cottontails to enter hollow logs or trees, we have been unable to find any published report of a cottontail that carried nesting material twelve and one-half feet up an inclined tree (48°) to build her nest nine and five-tenths feet (the perpendicular distance) above the ground, then give birth to five young there, and care for them until they were able to shift for themselves.

On May 19, two days after the young rabbits were found, the nest was again examined; four rabbits were still in the nest. They had grown nicely and looked as if they would probably open their eyes in a day or two.

At dusk on May 21, the nest was visited at 9:15 P. M. About five feet from the base of the old willow a rabbit, thought to be the mother, was seen; it ran away as we approached. The two young that were still in the nest had their eyes open, but two days later, on May 23, all of them were gone from the nest.—A. R. Shadle, T. S. Austin, and F. X. Meyer, *Biology Department, University of Buffalo, Buffalo, New York.*

TWENTY-SECOND ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The twenty-second annual meeting of the American Society of Mammalogists was held at Phipps Auditorium, Colorado Museum of Natural History, Denver, from June 25 to 27, 1940. There were 92 members and visitors present, representing 21 states and the District of Columbia.

PROGRAM

MONDAY, JUNE 24

9:00 *p.m.*

Meeting of the Board of Directors, Cosmopolitan Hotel

TUESDAY, JUNE 25

10:30 *a.m.*

1. Address of welcome. C. H. Hanington, President, The Colorado Museum of Natural History.
2. Response by George Willett, California; William H. Gates, Louisiana; and Vernon Bailey, Washington, D. C.
3. Invitation to visit Rocky Mountain National Park. Raymond Gregg, National Park Service.
4. A study of the hyoid apparatus of the Cricetinae. James M. Sprague, University of Kansas. Slides.
5. Handling animals without fright or injury. Vernon Bailey, Washington, D. C. Motion pictures.
6. Tularemia: Observations on infection in beaver in Montana. William L. Jellison, Rocky Mountain Laboratory, Hamilton, Montana. Slides and motion pictures.

2:00 *p.m.*

Annual Business Meeting of the Society

4:00 *p.m.*

7. Rabbits as prognosticators of the human race. Marcus Ward Lyon, Jr., South Bend, Indiana.
8. A phylogeny of North American Equidae, with observations on tooth structure as correlated with environment. R. A. Stirton, University of California. Slides.

7:00 *p.m.*

Open house and buffet supper at The Colorado Museum of Natural History for members, their families and friends.

8:15 *p.m.*

"Desert Islands of Mexico," by A. M. Bailey. Motion pictures. Phipps Auditorium.

WEDNESDAY, JUNE 26

9:00 *a.m.*

9. Oregon mammals, their natural history and behavior. Kenneth Gordon, Oregon State College. Motion pictures.

10. The life history and ecology of the white-throated wood rat in southern Arizona. Charles T. Vorhies and Walter P. Taylor, University of Arizona and U. S. Fish and Wildlife Service.
11. Life span of the smoky shrew, *Sorex fumeus*. William J. Hamilton, Jr., Cornell University. Slides.
12. A few notes on the evening bat, *Nycticeius humeralis*, in captivity. Wm. H. Gates, Louisiana State University. Slides.
13. Certain natural protective and other habits of mammals. Francis E. Garlough, U. S. Fish and Wildlife Service.

11:50 *a.m.*

Members of the Society assembled on the steps of The Colorado Museum of Natural History for a group picture.

2:00 *p.m.*

14. The Mammals of southern South America. Wilfred H. Osgood, Field Museum of Natural History.
15. Paleoecology of the Broadwater and Lisco localities (Lower Pleistocene) of western Nebraska. C. Bertrand Schultz and Thompson M. Stout, University of Nebraska. Slides.
16. The California red-backed mouse, *Clethrionomys californicus californicus* (Merriam), in the Oregon Coast Range. Jane Claire Dirks, University of Illinois. Slides.
17. Status of the elephant seal in the Channel Islands. Frank Overhauley, Sequoia National Park. Illustrated. Read by Victor H. Cahalane.
18. Age determination in *Phoca hispida*. J. Kenneth Doutt, Carnegie Museum. Slides.
19. Some notes on the peccary in Texas. Bernard E. Ludeman and Randolph L. Peterson, Texas Cooperative Wildlife Research Unit.
20. Texas wildlife. William B. Davis, Agricultural and Mechanical College of Texas. Motion pictures (courtesy Texas Game, Fish and Oyster Commission).

7:00 *p.m.*

The annual dinner of the Society was held at the Cosmopolitan Hotel, after which wildlife motion pictures were shown by Lowell J. Mills, of Denver. A special floor show by N.B.C. artists followed.

THURSDAY, JUNE 27

9:00 *a.m.*

21. Mammalian problems at Rocky Mountain National Park, Colorado. Fred M. Packard, National Park Service.
22. Colorado's research program relative to large mammals. Arthur Carhart, Colorado Game and Fish Commission.
23. Deer and elk studies in Colorado. James M. Coutts, Colorado Game and Fish Commission.
24. Bighorn sheep studies in Colorado. Herbert S. Wallace, Colorado Game and Fish Commission.
25. Elk losses on the Gros Ventre watershed, 1938. John W. Scott, University of Wyoming.
26. Some criteria for determining proper forage utilization by big game in winter ranges. Lloyd W. Swift, U. S. Forest Service.

27. Fur, a source of supplementary farm income in Brazos County, Texas. W. C. Glazener and John Carlisle, Texas Cooperative Wildlife Research Unit.

2:00 *p.m.*

28. Food of feral house cats in Oklahoma. Frank B. McMurry and Charles C. Sperry, U. S. Fish and Wildlife Service.
29. Modification of dental formulae and dental caries in wild carnivores. E. Raymond Hall, University of California. Slides.
30. By canoe to the Grand Falls, Labrador. J. Kenneth Doutt, Carnegie Museum. Motion pictures.
31. Relationships of the woodrats as shown by the baculum. W. H. Burt and F. S. Barkalow, Jr. University of Michigan and Alabama Department of Conservation. Slides.
32. A study of a series of mule deer skulls of known ages. D. I. Rasmussen, U. S. Fish and Wildlife Service. Slides.
33. Member of Hyaenidae from Upper Pliocene of North America. R. A. Stirton and Wayne B. Christian, University of California. Slides.
34. Wildlife in Mt. McKinley National Park. O. J. Murie, U. S. Fish and Wildlife Service. Motion pictures.

4:00 *p.m.*

Final business meeting of the Society

8:15 *p.m.*

Second American Alpine Club Expedition to the Himalayas. Jack Durrance, Hanover, New Hampshire. Illustrated. Phipps Auditorium.

FRIDAY, JUNE 28

7:00 *a.m.*

An all-day motor tour of the Rocky Mountain National Park and the "high country." The party left the Cosmopolitan Hotel at 7:00 a.m., passed through Boulder, thence up the picturesque Boulder Canyon to the University of Colorado's summer mountain laboratory, Science Lodge, where a late breakfast was served about 10 o'clock. After breakfast the party proceeded to the "high country" and returned to Denver in the evening by way of Rocky Mountain National Park.

At the meeting of the Board of Directors on June 24, Dr. William K. Gregory was re-elected as Trustee for 1940–1942. Mr. Arthur H. Howell was re-appointed as Chairman of the Editorial Board. President Jackson reported that all twenty volumes of the Journal of Mammalogy have been indexed on cards and that more than half of these have been re-checked. He stated that the index is expected to be ready for publication by the end of 1940.

At the annual business meeting on June 25, Walter P. Taylor was elected President. A. Brazier Howell and E. Raymond Hall were elected Vice-presidents. It was then moved, seconded and passed that the rules be suspended and the remaining officers be reinstated for another year as follows: Recording secretary, Robert T. Orr; Corresponding secretary, William B. Davis; Treasurer, Viola S. Schantz. The following additional directors were elected: George Willett, Colin C. Sanborn, William H. Burt, W. E. Saunders, and Joseph Dixon. The Secretary was instructed to cast an unanimous ballot for Victor H. Cahalane to fill the vacancy on the board created by the election of E. Raymond Hall to Vice-presidency.

On recommendation by the Board of Directors it was agreed to accept the invitation from the Director of the Field Museum of Natural History to hold the 1941 meeting of the Society in Chicago.

It was with deep regret that The Society learned of the deaths of eleven members, five of whom were charter (*) members: *A. W. Anthony, William H. Behney, John B. Burnham, Stuart T. Danforth, *Joseph Grinnell, *Edmund Heller, *Norman James, Robert Marshall, E. H. Perkins, *Witmer Stone, W. A. Welter.

The following is a summary of the report of the corresponding Secretary:

	1938	*1939*	*1940*
New members elected at annual meeting	106	75	77
New subscriptions received since last meeting	29	20	20
Total gross additions to mailing list	135	95	97
Resignations	16	20	21
Deaths reported	13	12	11
Subscribers delinquent	9	39	29
Annual members dropped for delinquency	33	30	31
Annual members delinquent two years	41	36	52
Annual members delinquent one year	71	106	87
Total gross loss to mailing list	183	253	231
Number of honorary members	4	4	3
Number of life members	52	50	51
Number of members in good standing	701	666	769
Total number of delinquent members	112	142	139
Total number of members	869	857	898
Members not receiving Journal	3	3	3
Number of paid subscribers	197	181	189
Total mailing list at this date	951	896	958

Reports of the following standing committees were read and accepted: Editorial, Life History and Ecology, Conservation of Land Mammals, Nomenclature.

The following resolution was adopted as an expression of appreciation for the courtesies extended to the American Society of Mammalogists at its Twenty-second Annual Meeting by the Colorado Museum of Natural History and the Local Committee on arrangements:

Resolved that the thanks of the American Society of Mammalogists be tendered to the President and Trustees of The Colorado Museum of Natural History, to the Director of the Museum, and to its staff and other members of the Local Committee for their generous hospitality and their effective arrangements, contributing to the success of the 22nd annual meeting and the enjoyment of all in attendance.

Be it resolved, also that the thanks of the Society be extended to the Superintendent and other members of the staff of the Rocky Mountain National Park for their generous cooperation in entertaining the Society by making the facilities of the Park available to its members.

Further, be it resolved that the thanks of the Society be extended to the University of Colorado for its pleasant part in the entertainment of the Society.

In addition at the final business meeting, held on June 27, the following two resolutions were adopted:

Whereas the American Society of Mammalogists has learned that on account of ravages of cattle-fever-ticks in Florida, thought to be harbored by the native deer,

the continued existence of not only the deer, but of the puma which preys upon them, is imminently threatened; and whereas both the deer and the pumas of Florida represent types peculiar to that region and the puma especially finds in Florida its last stand in the eastern United States,

Therefore, be it resolved that the American Society of Mammalogists regards this situation as one requiring the best possible information before further drastic action is taken.

Be it further resolved that a competent mammalogist should be employed to study this situation thoroughly and to make recommendations with the end that these valuable animals may be saved if possible.

Whereas the American Society of Mammalogists has learned that through the effort of conservation agencies the difficult, but highly desirable, reintroduction of the Woodland Caribou into northern Minnesota has been initiated. And whereas the introductory attempt appears to have a chance for ultimate success,

Therefore it is resolved that the Society commends this project and urges its continuance under competent supervision.

RECENT LITERATURE

[Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters]

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LIST OF MEMBERS OF THE AMERICAN SOCIETY OF MAMMALOGISTS

(Corrected to October 1940)

Names of life members are marked with an asterisk

Honorary Members

*MERRIAM, DR. C. HART, 2590 Cedar St., Berkeley, Calif.....(Charter) 1930
SCOTT, PROF. WILLIAM BERRYMAN, 7 Cleveland Lane, Princeton, N. J.....(1934) 1936
STEJNEGER, DR. LEONHARD, U. S. National Museum, Washington, D. C.....1937

Members

ABBOTT, CLINTON G., Natural History Museum, San Diego, Calif.....1922
ABEGG, ROLAND, Louisiana State Univ., Baton Rouge, La 1936
ADAMS, DR. CHARLES C., State Museum, Albany, N. Y.....Charter
ADAMS, HARRY, U. S Forest Service, White Cloud, Mich 1937
ADAMS, LOWELL, Kings River Camp, Trimmer Route, Sanger, Calif.....1938
ADAMS, WILLIAM C., Dept of Conservation, State Office Bldg., Albany, N. Y....1933
ADAMS, DR. ZABDIEL BOYLSTON, 43 Cottage Farm Rd., Brookline, Mass.....1936
AGACINO, EUGENIO MORALES, Museo Ciencias Naturales, Apartado Correos N 593, Barcelona, Spain.....1933
ALCORN, RAY, Museum of Vertebrate Zoology, Berkeley, Calif.....1939
ALDOUS, CLARENCE M., % U. S. Forest Service, Ogden, Utah.....1931
ALDOUS, SHALER E., Lake States Forest Exper. Sta., Univ. Farm, St. Paul, Minn.....1927
*ALEXANDER, ANNIE M., Suisun, Calif.....Charter
ALEXANDER, PHILIP K., JR., 140 Humboldt St., Denver, Colo.....1939
ALLAN, PHILIP F., 806 Bellview St., Amarillo, Tex.....1931
ALLEN, DR. ARTHUR A., Fernow Hall, Ithaca, N. Y.....Charter

ALLEN, DR. DURWARD L., Rose Lake Wildlife Exper. Sta., East Lansing, Mich..1938
*ALLEN, DR. GLOVER M., Museum of Comparative Zoology, Cambridge, Mass..Charter
ALLEN, ROBERT W., Ossian, Iowa.....1937
*ALLIS, DR. EDWARD PHELPS, JR., Palais de Carnoles, Menton (A.M.), France...1922
ALLISON, MALCOLM N., P. O. Box 869, Yuma, Ariz.....1938
ALLISON, VERNON C., Picatinny Arsenal, Dover, N. J.....1930
AMADON, DEAN, 300 Windsore Place, Brooklyn, New York.....1938
ANDERSON, JOHN, Ohio Wildlife Research Unit, Ohio State Univ., Columbus, Ohio.....1939
ANDERSON, DR. RUDOLPH M., National Museum of Canada, Ottawa, Ontario.....Charter
ANDREWS, DR. ROY C., Amer. Museum Nat. Hist., New York City, N. Y.....Charter
ANTHONY, DR. H. E., Amer. Museum Nat. Hist., New York City, N. Y.....Charter
*ARCHBOLD, RICHARD, Amer. Museum Nat. Hist., 79th St., and Central Park West, New York City, N. Y.....1929
ARENDALE, JOHN MORRIS, JR., Box 283, College Station, Tex.....1939
ARLTON, DR. ALEXANDER V., Dakota Wesleyan Univ., Mitchell, S. D.....1936
ARNOLD, Lee W., Dept. of Econ. Zool., Box 4063, Univ. Sta., Tucson, Ariz.....1940
ARVEY, DALE, Dept. of Biology, Univ. of Idaho, Moscow, Idaho.....1938
*ATKINSON, HARRY WATERS, 10 Bishop Road, Guilford, Baltimore, Md.....1925
ATZ, JAMES W., 697 Tremont Court, Orange, N. J.....1936
ATZENHOEFER, D. R., 12 State St., Norwalk, Ohio.....1940
AUSTIN, DR. OLIVER L., SR., Tuckahoe, Westchester Co., N. Y.....1930
AUSTIN, T. S., Biological Dept., Univ. of Buffalo, Buffalo, N. Y.....1939
AYER, MRS. RICHARD G. L., Acad. Nat. Sciences, Philadelphia, Pa.....1936
BAILEY, ALFRED M., Colorado Museum of Natural History, Denver, Colo.....Charter
BAILEY, HAROLD H., 820 Alhambra Circle, Coral Gables, Fla.....Charter
*BAILEY, DR. JOHN W., Box 107, Univ. of Richmond, Richmond, Va.....1927
*BAILEY, Vernon, 1834 Kalorama Road, Washington, D. C.....Charter
BAKER, ROLLIN HAROLD, Geology Dept., College Station, Tex.....1938
BALDWIN, WILLIAM P., JR., Bull's Island, Awendaw, South Carolina.....1939
BANFIELD, FRANK A., 932-A Avenue Rd., Toronto, Ontario.....1938
*BANNON, HENRY, First National Bank Bldg., Portsmouth, Ohio.....1922
*BARBOUR, DR. THOMAS, Museum of Comparative Zoology, Cambridge, Mass..Charter
BARKALOW, FRED S., JR., Box 469, Auburn, Ala.....1934
BARNES, CLAUDE T., 359 10th Ave., Salt Lake City, Utah.....Charter
BARR, ARTHUR, 602 Summit, Pasadena, Calif.....1938
BARRETT, CHARLES H. M., 1339 Valley Place, S. E., Washington, D. C.....Charter
BARRETT, LEONARD I., 223 Federal Bldg., Asheville, N. C.....1932
BARRETT, DR. OTIS WARREN, 127 W. 43rd St., New York City, N. Y.....1934
BARRINGTON, B. A., Dept. of Biology, Univ. of Florida, Gainesville, Fla.....1940
BARTLETT, ILO H., 125 Fern St., East Lansing, Mich.....1930
BARTO, MISS ELIZABETH, Lab. of Vertebrate Genetics, Univ. of Michigan, Ann Arbor, Mich.....1938
BARTSCH, DR. PAUL, U. S. National Museum, Washington, D. C.....1921
BATCHELDER, CHARLES F., 7 Kirkland St., Cambridge, Mass.....Charter
BAUMGARTNER, LUTHER, Wildlife Research Sta., Ohio State Univ., Columbus, Ohio.....1937
BAY, DR. J. CHRISTIAN, The John Crerar Library, 86 E. Randolph St., Chicago, Ill..1931
*BEACH, WILLIAM N., Room 1518, 551 Fifth Ave., New York City, N. Y.....Charter
BEAN, EDWARD H., Box 119, Brookfield, Ill.....1939

BEARD, D. BARTLETT, National Park Service, Washington, D. C.....1935
BEAUX, DR. OSCAR DE, % Libreria Mario Bozzi, via Cairoli, 6, Genoa, Italy.....1930
BEEBE, WILLIAM, 33 W. 67th St., New York City, N. Y.....Charter
BEER, JAMES, Rt. 2, Box 125, Battle Ground, Washington.....1940
BEHLE, DR. WILLIAM HARROUN, Dept. of Biology, Univ. of Utah, Salt Lake City, Utah.....1936
BELL, J. FREDERICK, Dept. Veterinary Medicine, Univ. of Pennsylvania, Philadelphia, Pa.....1938
BELL, DR. WILLIAM B., 803 Rittenhouse St., N. W., Washington, D. C.....Charter
BENNETT, DR. LOGAN J., 1-A Horticulture Bldg., State College, Pa.....1939
BENNITT, DR. RUDOLF, Dept of Zoology, Univ. of Missouri, Columbia, Mo.....1937
BENSON, DR. SETH B., Museum of Vertebrate Zoology, Berkeley, Calif.....1928
BEULE, JOHN DAVID, R. D. 2, Montoursville, Pa.....1939
BEZDEK, HUBERT, Ohio Wildlife Research Sta., Columbus, Ohio.....1939
BINEGAR, HALDEN H., 5707 Dublin Rd., Amlin, Ohio.....1940
BIRD, DR. RALPH D., P. O. Box 250, Brandon, Manitoba.....1926
BIRDSEYE, CLARENCE, Birdseye Laboratories, Gloucester, Mass.....1933
BISHOP, DR. LOUIS B., 450 Bradford St., Pasadena, Calif.....1927
BISHOP, DR. SHERMAN C., Dept. of Biology, Univ. of Rochester, Rochester, N. Y.....Charter
BLAIN, DR. ALEXANDER W., 2201 Jefferson Ave. E., Detroit, Mich.....1926
BLAIR, DR. WILLIAM FRANK, Mus. of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1936
BLAIR, DR. W. REID, N. Y. Zoological Society, 183 St. & Southern Blvd., Bronx, New York City, N. Y.....1927
BLAKE, PROF, IRVING H., Dept of Zoology, Univ. of Nebraska, Lincoln, Nebr...Charter
BLAKEY, HAROLD L., Fish and Wildlife Service, Dept of Interior, Box 231, Charleston, S. C.....1938
BLOSSOM. PHILIP M., Mus. of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1929
BLUNTSCHLI, DR. HANS, Aebistrasse, 9, Bern, Switzerland.....1930
BLYTH, DAVID, Wildlife Research Sta., Ohio State Univ., Columbus, Ohio.....1939
BODE, I. T., State Conservation Commission, Jefferson City, Mo.....1936
BOHN, HERMAN L., 3329 171st St., Flushing, N. Y.....1938
BOLE, BENJAMIN PATTERSON, Lake Shore Blvd. and Bratenahl Rd., Cleveland, Ohio.....1938
BOLE, BENJAMIN P., JR., Mus. of Natural History, 2717 Euclid Ave., Cleveland, Ohio.....1930
BOLT, BENJAMIN F., 5300 Brookside Blvd., Kansas City, Mo.....Charter
BOND, DR. RICHARD M., 6608 Chabot Rd., Oakland, Calif.....1939
BONNYCASTLE, R. H. G., Hudson's Bay Company, Winnipeg, Manitoba.....1939
BORDEN, C. B., Woodstock, Vt.....1940
*BORDEN, JOHN, Box 442, Muskegon, Mich.....1928
BORELL, ADREY E., Box 227, Albuquerque, N. M.....1925
BORGFELD, H. O., JR., Dept of Fish & Game, College Station, Tex.....1939
BORISSIAK, Dr. A. A., Spiridonovka 24, KV. 34, Moscow, U.S.S.R.....1933
BORUM, MRS. M. C., Pearl & High Sts., Natchez, Miss.....1940
BOWDISH, BEECHER S., Demarest, N. J.....1921
BOWLUS, MISS H. LORRAINE, 614 Franklin St., Whittier, Calif.....1938
BOWN, MISS OLIVE LYNDA, 6210 Wellesley Ave., Pittsburgh, Pa.....1935
BRADT, DR. G. W., 704 Leslie Ave., Lansing, Mich.....1927
*BRANDRETH, COURTENAY, Ossining, N. Y.....1921

BRAY, ROBERT S., 3231 N. Albemarle St., Arlington, Va.....1939
BRECK, MRS. EDWARD, 1504 31st St., N. W., Washington, D. C.....1930
BRECKENRIDGE, W. J., Museum of Natural History, Univ. of Minnesota, Minneapolis, Minn.....1932
BREWER, DR. GEORGE E., 151 E. 79th St., New York City, N. Y.....1934
BRIMLEY, H. H., State Mus., Raleigh, N. C.....Charter
BROADBOOKS, HAROLD, 327 E. William St., Ann Arbor, Mich.....1939
BRODE, J. STANLEY, Santa Monica Junior College, Santa Monica, Calif.....1936
BROOKS, REV. EARLE A., 166 Plymouth Rd., Newton Highlands, Mass.....1921
BROOMAN, RONALD C., Bank of Montreal, St. Thomas, Ontario.....1939
BROWMAN, DR. LUDWIG G., Dept. of Zoology, Montana State Univ., Missoula, Mont.....1940
BROWN, CHARLES PHILIP, Millers Mills, N. Y.....1939
BROWN, F. MARTIN, Fountain Valley School, Colorado Springs, Colo.....1926
BROWN, LOUIS G., Box 36, Griggsville, Ill.....1940
BRUMWELL, MALCOLM, Museum of Birds & Mammals, Univ. of Kansas, Lawrence, Kan.....1940
BRYAN, H. R., 115 Oakes Blvd., San Leandro, Calif.....1939
BRYANT, FRANKLYN A., Box 12, Jasper, Alberta.....1939
BRYANT, DR. HAROLD C., Kings Canyon National Park, Calif.....Charter
BRYANT, MONROE DAVID, Museum Vertebrate Zoology, Berkeley, Calif.....1940
BUCHANAN, BORDEN, 100 S. Cecelia St., Sioux City, Iowa.....1940
BUCHANAN, W. J., Amer. Museum Nat. Hist., New York City, N. Y.....1940
BUCHER, G. C., Apartado 470, Santiago de Cuba, Cuba.....1936
BUCK, ELLSWORTH B., Pier 23, Rosebank, Staten Island, N. Y.....1940
BUJAK, B. JOSEPH, Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1936
BULLOCK, D. S., Casilla 2-d, Angol, Chile.....1921
BURGESS, THORNTON W., 61 Washington Rd., Springfield, Mass.....Charter
BURKE, J. J., Carnegie Museum, Pittsburgh, Pa.....1935
BURMEISTER, MELVIN, 6143 Melrose St., Chicago, Ill.....1938
BURNS, FRANK L., Berwyn, Pa.....Charter
BURROUGHS, RAYMOND DARWIN, Game Division, Dept. of Conservation, Lansing, Mich.....1938
BURT, DR. CHARLES EARLE, Southwestern College, Winfield, Kan.....1932
BURT, DR. WILLIAM H., Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1926
CABOT, WILLIAM BROOKS, 447 Marlboro St., Boston, Mass.....1922
CABRERA, ANGEL, Museo de la Plata, La Plata, Argentina.....Charter
CADWALADER, CHARLES M. B., Fort Washington, Pa.....1930
*CADWALADER, DR. WILLIAMS B., 133 S. 36th St., Philadelphia, Pa.....1924
CADY, EARL R., Box 444, Norris, Tenn.....1939
CAHALANE, VICTOR H., Fish and Wildlife Service, Dept. Interior, Washington, D. C.....1930
CAHN, DR. ALVIN R., Forestry Bldg., Norris, Tenn.....1921
CALDWELL, DR. GEORGE THORNHILL, University Station, Box 4051, Tucson, Ariz.....1922
CALHOUN, JOHN B., Dept. of Zoology, Northwestern Univ., Evanston, Ill.....1940
CAMPBELL, DR. BERRY, Dept. of Anatomy, Oklahoma Medical School, Oklahoma City, Okla.....1934
CAMPBELL, JOHN S., Forestry Dept., Louisiana State Univ., University, La.....1939
CARPENTER, DR. C. R., Dept. of Education & Psychology, State College, Pa.....1935
CARR, WILLIAM H., Amer. Museum Nat. Hist., New York City, N. Y.....1926

CARROLL, DR. MITCHEL, Franklin & Marshall College, Lancaster, Pa.....1922
CARTER, T. DONALD, Amer. Museum Nat. Hist., New York City, N. Y.....1922
CASAMAJOR, PROF. LOUIS, 706 W. 168th St., New York City, N. Y.....1922
CASE, DR. E. C., University Museums, Univ. of Michigan, Ann Arbor, Mich..Charter
CASTLE, DR. WILLIAM E., Hilgard Hall, Univ. of California, Berkeley, Calif.....1930
CHAFFEE, ROBERT G., 254 S. 16th St., Philadelphia, Pa.....1936
CHAMBERLAIN, EDWARD B., The Charleston Museum, Charleston, S. C.....1924
CHAPIN, DR. JAMES P., Amer. Museum Nat. Hist., New York City, N. Y....Charter
CHAPMAN, DR. FLOYD B., 1944 Denune Ave., Columbus, Ohio.....1937
CHAPMAN, DR. WENDELL SHERMAN, 5 La Punta, Orinda, Calif.....1935
CHARO, WALTER J., 6536 Rogers Ave., Cleveland, Ohio.....1939
CHARTERS, EMMA M., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1921
CHASE, HENRY BRIGHT, JR., 517 Decatur St., New Orleans, La.....1924
CHATTIN, JOHN ELMER, 1934 Yolo Ave., Berkeley, Calif.....1939
CHAWORTH-MUSTERS, JAMES LAWRENCE, British Mus. (Natural History), Cromwell Rd., London, S. W. 7, England.....1934
CHEESMAN, WILLIAM H., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....Charter
CHRISTIAN, WAYNE G., Box 664, Canyon, Texas.....1940
CHURCH, MORTON L., 1626 Queens Rd. W., Charlotte, N. C.....Charter
CLARK, ELTON, Pomfret, Vt.....Charter
CLARK, DR. JAMES L., Amer. Museum Nat. Hist., New York City, N. Y.....1926
CLARKE, C. H. D., National Parks Bureau, Dept. of Mines and Resources, Ottawa, Ontario.....1938
CLARKE, DR. WILLIAM C., Cornwall Bridge, Conn.....1931
CLEMENTS, DR. FREDERIC E., Mission Canyon, Santa Barbara, Calif.....1927
COBB, DR. W. MONTAGUE, Dept. of Anatomy, Howard Univ., Washington, D. C....1933
COLBERT, DR. EDWIN H., Amer. Museum Nat. Hist., New York City, N. Y.....1930
*COLBURN, ALBERT E., 3100 Wilshire Blvd., Los Angeles, Calif.....Charter
COLE, DR. LEON J., College of Agriculture, Univ. of Wisconsin, Madison, Wis.....1922
COLEMAN, HENRY SHIRL, Box 254FE, College Station, Tex.....1940
COLEMAN, ROBERT H., Route 4, Box 212, Charleston, S. C.....1928
COLEMAN, THOMAS CYRIL, 2251 Hearst Ave., Berkeley, Calif.....1938
*COLTON, HAROLD S., Box 127, Flagstaff, Ariz.....1927
COMPTON, LAWRENCE V., Soil Conservation Service, Box 1438, Albuquerque, N. M.....1929
CONISBEE, L. R., Woodfield, Sandpit Lane, St. Albans, England.....1936
COOK, ARTHUR H., State Conservation Dept., Bureau of Game, Albany, N. Y.....1939
COOK, DAVID B., 12 McPherson Terrace, Albany, N. Y.....1940
COOK, MISS FANNYE A., 646 North St., Jackson, Miss.....1925
COOKSON, MRS. MARY SNYDER, 9303 Montgomery Ave., Chevy Chase, Md.....1932
COOLIDGE, HAROLD J., JR., Museum of Comparative Zoology, Cambridge, Mass...1926
COPELAND, DR. MANTON, Bowdoin College, Brunswick, Maine.....Charter
COTTAM, DR. CLARENCE, Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1929
COUCH, LEO K., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....Charter
COVENTRY, A. F. Dept. of Biology, Univ. of Toronto, Toronto, Ontario.....1935
COWAN, DR. IAN MCTAGGART, Dept. of Zoology, University of British Columbia, Vancouver, B. C.....1933

Crabb, Wilfred D., Salix, Iowa.....1940
Crandall, Lee S., New York Zoological Park, New York City, N. Y.....1922
Cresson, Samuel Lukens, 527 Riverview Rd., Swarthmore, Pa.....1938
Criddle, Stuart, Treesbank, Manitoba.....Charter
Cross, E. C., Royal Ontario Mus. of Zoology, Toronto, Ontario.....1936
Cross, W. Redmond, Bernardsville, N. J.....1922
Crowe, Peter Emmett, The Knoll, Ithaca, N. Y.....1940
*Cudahy, John, 95 E. Wisconsin Ave., Milwaukee, Wis.....1923
Culbertson, A. E., Dept. of Biology, Fresno State Teachers College, Fresno, Calif.....1938
Cutright, Dr. Paul Russell, Beaver College, Jenkintown, Pa.....1940
*Cutting, Charles Suydam, 32 Nassau St., New York City, N. Y.....1930
Dale, Frederick H., Game Division, Dept. of Conservation, Lansing, Mich.....1935
Dalke, Dr. Paul D., Fish and Wildlife Service, Dept. of Interior, Univ. of Missouri, Columbia, Mo.....1928
Dalquest, Walter, 6521 17th Ave. N. E., Seattle, Wash.....1937
Dammerman, Karel Willem, Zoological Museum & Laboratory, Buitenzorg, Java.....Charter
Damon, David, 724 6th St., Ames, Iowa.....1935
Darling, Prof. C. A., Dept. of Biology, Allegheny College, Meadville, Pa.....1935
Darrow, Robert W., 7 Rural Place, Elsmere, N. Y.....1932
Davis, David E., 721 Elmwood Ave., Wilmette, Ill.....1936
Davis, David Herbert S., Dept. of Public Health, P. O. Box 386, Pretoria, South Africa.....1938
Davis, Eli, R. R. 7, London, Ontario.....1930
Davis, George W., Fish and Game Service, Montpelier, Vt.....1935
Davis, Dr. William B., Dept. of Fish and Game, Texas A. and M. College, College Station, Tex.....1934
*Davis, William T., 146 Stuyvesant Place, Staten Island, N. Y.....1922
Day, Albert M., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1937
Dearborn, Dr. Ned, Hilton Village, Va.....Charter
Deichmann, Miss Elizabeth, Museum of Comparative Zoology, Cambridge, Mass.....1925
De Lury, Ralph E., Dominion Observatory, Ottawa, Ontario.....1925
Demeritt, Prof. D. B., Dept. of Forestry, Univ. of Maine, Orono, Maine.....1936
Dice, Dr. Lee R., Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....Charter
Dille, Frederick M., 822 Grand Ave. Nogales, Ariz.....Charter
Dillehunt, Harry B., Jr., 214 W. Read St., Baltimore, Md.....1926
Dimick, R. E., Dept. of Fish and Game Management, Oregon State College, Corvallis, Oreg.....1938
Ditmars, Dr. Raymond L., New York Zoological Park, The Bronx, New York City, N. Y.....1921
Dixon, Joseph S., 1735 Allston Way, Berkeley, Calif.....Charter
*Dolan, Brooke, 2d, Villa Nova, Pa.....1933
Donahue, Mrs. R. W., Peabody Museum Library, Yale Univ., New Haven, Conn.....1930
Doremus, Henry M., Stimson Hall, Cornell Univ., Ithaca, N. Y.....1940
Doutt, J. Kenneth, Carnegie Museum, Pittsburgh, Pa.....1927
Dozier, Herbert L., U. S. Fur Animal Field Sta., Blackwater Refuge, Cambridge, Md.....1940

DREYER, MRS. OLIVER, 300 E. Broad St., Texarkana, Ark.....1939
DUFF, JOHN R., Public Works Dept., Christchurch, New Zealand.....1925
DUFFIELD, MRS. J. W., Forest Experiment Sta., 335 Prospect St., New Haven, Conn.....1940
DUNK, F. A., Provincial Mus., Normal School, Regina, Saskatchewan.....1930
DUNN, PROF. E. R., Haverford College, Haverford, Pa.....1927
DURHAM, FLOYD E., Museum of Vertebrate Zoology, Univ. of California, Berkeley, Calif.....1938
DURRANT, STEPHEN DAVID, Dept. of Zoology, Univ. of Utah, Salt Lake City, Utah.1933
DWINELLE, J. K., 424 S. Yellowstone, Livingston, Mont.....1936
EADIE, W. ROBERT, 8 Rosemary Lane, Durham, N. H.....1936
EARNSHAW, FRANK L., 1343 Mapleview Pl. S. E., Washington, D. C.....1940
EASTWOOD, SIDNEY K., 301 S. Winebiddle Ave., Pittsburgh, Pa.....1929
EDGE, MRS. CHARLES N., 1200 Fifth Ave., New York City.....1930
EDGE, DR. ELTON R., San Bernardino Valley Union Jr. College, San Bernardino, Calif.....1931
EDINGER, DR. TILLY, % Dr. Sichel, 6 Sunnymead Terrace, Brighton, Mass.....1933
EDMINSTER, FRANK C., 312 Lincoln Ave., Lansdowne, Pa.....1938
EHIK, DR. JULIUS, Hungarian National Museum, Budapest, 80, Hungary.....1923
EIFRIG, PROF. C. W. G., 1029 Monroe Ave., River Forest, Ill.....Charter
EINARSEN, ARTHUR S., Fish and Wildlife Service, Dept of Interior, % Oregon State College, Corvallis, Oreg.....1938
EKBLAW, DR. W. ELMER, Clark Univ., Worcester, Mass.....1921
ELFTMAN, DR. HERBERT, 407 Park Ave., Leonia, New Jersey.....1926
ELLIOTT, CHARLES N., 421 State Capitol, Atlanta, Ga.....1938
ELLIOTT, MRS. JANE S., 1841 Columbia Road, N.W. Washington, D. C.....Charter
*ELLIS, RALPH, 2420 Ridge Road, Berkeley, Calif.....1926
ELTON, CHARLES, University Mus., Oxford, England.....1931
EMILIO, S. GILBERT, 7 Winter St., Salem, Mass.....1937
EMLEN, DR. JOHN THOMPSON, JR., College of Agriculture, Davis, Calif.....1934
ENDERS, DR. ROBERT KENDALL, Edward Martin Biological Lab., Swarthmore, Pa..1924
ENGELS, DR. WILLIAM L., Dept. of Zoology, Univ. of North Carolina, Chapel Hill, N. C.....1930
ENGLISH, DR. PENNOYER F., Dept. of Zoology, Pennsylvania State College, State College, Pa.....1922
ERICKSON, ARNOLD B., Division of Economic Zoology, Univ. of Minnesota, St. Paul, Minn.....1938
ERRINGTON, DR. PAUL L., Insectary, Iowa State College, Ames, Iowa.....1933
EVANS, DR. THOMAS HORACE, 350 S. Main St., Freeport, N. Y.....1935
EVANS, THOMAS R., 413 N. Pine St., Caledonia, Minn.....1936
EWING, DR. H. E., U. S. National Museum, Washington, D. C.....1923
EYERDAM, WALTER J., 7531 19th St., N. E., Seattle, Wash.....1931
FAGERGREN, FRED C., Springdale, Zion National Park, Utah.....1939
FARGO, WILLIAM G., 506 Union St., Jackson, Mich.....1928
FENTON, LOWELL DEL, 925 Ordway St., Albany, Calif.....1938
FESTA, DR. ENRICO, Regio Museo Zoologico, Via Accademia Albertina, 17, Torino, Italy.....1925
FICHTER, EDSON HARVEY, JR., 22 Bessey Hall, Univ. of Nebraska, Lincoln, Nebr..1940
FIGGINS, J. D., The Britling, 343 S. Broadway, Lexington, Ky.....Charter
FILLEY, OLIVER D., Bernardsville, N. J.....1930
FINLEY, WILLIAM L., Box 426 A, Route 10, Portland, Oreg.....Charter

FISHER, MISS EDNA M., 2410 Fulton St., Berkeley, Calif.....1928
FITCH, DR. CLIFFORD PENNY, University Farm, St. Paul, Minn.....1937
FITCH, DR. HENRY SHELDON, San Joaquin Experimental Range, O'Neals, Calif.....1940
FLAIM, FRANCIS R., Santa Clara Univ., Santa Clara, Calif.....1939
FLEMING, J. H., 267 Rusholme Rd., Toronto, Ontario.....Charter
FLETCHER, JOHN F. S., Dimock, Pa.....1940
FOLLETT, RICHARD E., 2224 Dime Bank Bldg., Detroit, Mich.....1926
FORTUYN, DR. A. B. DROOGLEEVER, Peiping Union Medical College, Peking, China.....1932
FOSSLER, MABLE, 550 N. Los Robles Ave., Pasadena, Calif.....1938
FOSSLER, MARY LOUISE, 550 N. Los Robles Ave., Pasadena, Calif.....1938
FOSTER, FRANK B., Montcalm Farms, Phoenixville, Pa.....1926
FOX, ADRIAN CASPER, Box 593, U. S. Soil Conservation Service, Mandan, N. D..1935
FOX, HERBERT, Zoological Society of Philadelphia, Philadelphia, Pa.....1927
FRASER, DR. CHARLES M., Univ. of British Columbia, Vancouver, B. C.....1921
FREDINE, C. GORDON, 1807 Wesley Ave., St. Paul, Minn.....1937
FREEMAN, ROBERT M., Route 5, Laurel, Miss.....1940
*FRICK, CHILDS, Roslyn, Long Island, N. Y.....Charter
FRICKE, REINHOLD L., Carnegie Museum, Pittsburgh, Pa.....1932
FRILEY, CHARLES E., JR., 1726 N. 15th St., Abilene, Tex.....1939
FROST, WILFRED T., Crater Lake National Park, Fort Klamath, Oreg.....1937
FRY, WILLIAM W., 6420 Cecil Ave., St. Louis, Mo.....1933
FULLER, ARTHUR B., Broadmoor Rd., Midland Moor, Mentor, Ohio.....Charter
FULTON, HAROLD, JR., 135 N. Chatsworth Ave., Larchmont, N. Y.....1940
FULTON, DR. JOHN F., Lab. of Physiology, 333 Cedar St., New Haven, Conn.....1939
FURLONG, PROF. E. L., California Inst. Technology, Pasadena, Calif.....1925
GABRIELSON, DR. IRA N., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....Charter
GALBREATH, EDWIN C., Box 3, Ashmore, Ill.....1940
GARLOUGH, F. E., Colonial Village, Apt. 366, 1853 Wilson Blvd., Arlington, Va.....1940
GARRATT, GEORGE G., JR., Dorset Rd., Devon, Pa.....1939
GARRETT, ROBERT S., Lafayette, Calif.....1938
GATES, DR. WILLIAM H., University Sta., Baton Rouge, La.....1930
GAULT, BENJAMIN T., 413 Hill Ave., Glen Ellyn, Ill.....Charter
GAZIN, DR. CHARLES LEWIS, U. S. National Museum, Washington, D. C.....1931
GEIST, OTTO W., Museum Dept., Univ. of Alaska, College, Alaska.....1931
GENSCH, ROBERT, Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1938
GEORGE, IRA D., Dept. of Zoology, Louisiana State Univ., Baton Rouge, La.....1940
GERSTELL, RICHARD, Pennsylvania Game Commission, Harrisburg, Pa.....1940
GHIGI, PROF. ALESSANDRO, Dept. of Zoology, Univ. of Bologna, Bologna, Italy..1926
GIFFORD, CLAY L., 253 E. Greene St., Waynesburg, Pa.....1939
GILBERT, PERRY, Dept. of Zoology, Cornell Univ., Ithaca, N. Y.....1938
GILMORE, RAYMOND M., 49 W. 49th St., New York City, N. Y.....1927
GLAZENOR, WILLIAM CALEB, College Station, Texas.....1940
GLOYD, DR. HOWARD KAY, Chicago Academy of Sciences, 2001 N. Clark St., Chicago, Ill.....1922
GOLDMAN, EDWARD A., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....Charter
GOLDMAN, LUTHER C., Box 1242, Brawley, Calif.....1937
GOLDSMITH, DR. G. W., Box 1611, University Sta., Austin, Tex.....1922

GOODNIGHT, DR. CLARENCE JAMES, 203 Vivarium Bldg., Champaign, Ill.....1940
GOODRUM, PHIL, Texas Game, Fish & Oyster Commission, Austin, Tex.....1939
GOODWIN, GEORGE G., Amer. Museum Nat. Hist., New York City, N. Y.....1921
GORDON, KENNETH, Oregon State College, Corvallis, Oreg.....1936
GORHAM, DR. FRANK W., 703 Clement St., San Francisco, Calif.....1936
GOSLIN, ROBERT, 316 Wilson Ave., Columbus, Ohio.....1932
GOULD, VIRGIL A., Buhl, Idaho.....1939
GRANGER, DR. WALTER W., Amer. Museum Nat. Hist., New York City, N. Y..Charter
GRANT, CLEVELAND P., 620 Greenup St., Covington, Ky.....1926
GRAY, A. E., 1912 N. W. 21st St., Oklahoma City, Okla.....1924
GRAY, JOHN ALBERT, JR., 4209 Idaho St., San Diego, Calif.....1938
*GREEN, MORRIS MILLER, 39 S. Wyoming Ave., Ardmore, Pa.....1924
GREEN, DR. ROBERT GLADDING, 223 Millard Hall, University Campus, Minneapolis, Minn.....1933
GREFFENIUS, RUBEN J. E., Bears Ears Ranger Sta., U. S. Forest Service, Hayden, Colo.....1937
GREGORY, JOSEPH TRACY, Bureau of Economic Geology, Univ. of Texas, Austin, Tex.....1938
GREGORY, S. S., JR., Box N., Winnetka, Ill.....1927
*GREGORY, TAPPAN, 19 S. La Salle St., Chicago, Ill.....1925
GREGORY, DR. WILLIAM K., Amer. Museum Nat. Hist., New York City, N. Y..Charter
GRIFFIN, DONALD R., Biological Laboratories, Harvard Univ., Cambridge, Mass..1929
GRINNELL, MRS. JOSEPH, 2737 Forest Ave., Berkeley, Calif.....1923
GROSVENOR, GILBERT, Hubbard Memorial Hall, 16th & M Sts., N. W., Washington, D. C.....1921
GUNTER, DR. GORDON, Game, Fish and Oyster Commission, Rockport, Texas....1940
GUTHRIE, DR. MARY J., Lefevre Hall, Univ. of Missouri, Columbia, Mo.....1930
GYGER, DR. MAY KATHARYN, Dept. of Entomology, Cornell Univ., Ithaca, N. Y....1934
GYLDENSTOLPE, COUNT NILS, Naturhistoriska Riksmuseum, Stockholm, 50, Sweden.....Charter
HAAG, WILLIAM G., Museum of Anthropology and Archeology, Univ. of Kentucky, Lexington, Ky.....1936
HADSALL, DR. LEO F., Fresno State College, Fresno, Calif.....1936
HAECKER, HAROLD H., Box 1317, Sacramento, Calif.....1936
HAHN, HENRY C., P. O. Box 944, San Angelo, Texas.....1940
HALL, DR. E. RAYMOND, Museum of Vertebrate Zoology, Berkeley, Calif.....1923
HALL, DR. F. GREGORY, Duke Univ., Durham, N. C.....Charter
HALLER, KARL W., 3 Martindill Terrace, Maple Ave., Woodsdale, Wheeling, W. Va.....1938
HALLORAN, ARTHUR FRANKLIN, Dept. of Fish and Game, Texas A. and M. College, College Station, Tex.....1934
HAMERSTROM, MRS. FRANCES, Plainfield, Wis.....1938
HAMILTON, DR. WILLIAM JOHN, JR., Dept. of Zoology, Cornell Univ., Ithaca, N. Y..1924
HAMPE, IRVING EDWARD, 3909 Wilkins Ave., Baltimore, Md.....1936
HANDLEY, CHARLES O., Fish and Wildlife Service, Dept. of Interior, Blacksburg, Va.....1938
HARDY, ROSS, Dixie College, St. George, Utah.....1938
HARPER, DR. FRANCIS, 224 S. Chester Rd., Swarthmore, Pa.....Charter
HARRIS, VAN T., 7 Wildlife Bldg., Univ. of Missouri, Columbia, Mo.....1940
*HARRIS, WILLIAM PICKETT, JR., 15410 Windmill Point Drive, Grosse Pointe Park, Mich.....1924

HARRISON, GEORGE L., 1520 Locust St., Philadelphia, Pa.....Charter
HARTMAN, PROF. CARL G., Carnegie Lab. of Embryology, Johns Hopkins Medical School, Baltimore, Md.....1921
HARWELL, C. A., Yosemite Museum, Yosemite National Park, Calif.....1927
HARWOOD. P. LEROY, The Mariners Savings Bank, New London, Conn.....1932
HASKIN, NAGEL, 54 Flower Ave., Takoma Park, Md.....1926
HATFIELD, DR. DONALD M., Chicago Academy of Sciences, Chicago, Ill.....1933
HATT, DR. ROBERT T., Cranbrook Institute of Science, Bloomfield Hills, Mich.....1921
HAUGEN, ARNOLD O., Game Division, Dept. of Conservation, Lansing, Mich.....1937
HAVEN, HERBERT M. W., 500 Forest Ave., Portland, Maine.....Charter
HAWBECKER, A. C., 824 Lincoln St., Watsonville, Calif.....1937
HAWKINS, ARTHUR S., 219 Natural History Bldg., Urbana, Ill.....1935
HAYNE, DON, Dept. of Zoology, Michigan State College, East Lansing, Mich..1933
HAYS, H. A., Provencal, La.....1939
HAYWARD, C. LYNN, Dept. of Zoology, Brigham Young Univ., Provo, Utah.....1938
HECK, DR. LUDWIG, Budapesterstr. 9, Berlin W 62, Germany.....1928
HEILNER, VAN CAMPEN, Spring Lake Beach, N. J.....1928
HEIT, WILLIAM S., 187 High St., Geneva, N. Y.....1940
HELLMAN, DR. MILO, 57 W. 57th St., New York City, N. Y.....1921
HELME, ARTHUR H., 223 Bayview Terrace, Port Jefferson, N. Y.....Charter
HELMUTH, DR. WILLIAM TOD, 3D, East Hampton, Long Island, N. Y.....1932
HENDERSON, WALTER C., 8 Magnolia Parkway, Chevy Chase, Md.....Charter
HENDRICKSON, GEORGE O., Dept. of Zoology and Entomology, Iowa State College, Ames, Iowa.....1937
HENN, DR. ARTHUR W., Carnegie Museum, Pittsburgh, Pa.....1930
HEPTNER, DR. VLADIMIR G., Mal. Vusowsky 3, KV 2., Moscow, U.S.S.R.....1932
HERING, PAUL E., Social Circle, Ga.....1930
HERPICH, FRED C., Peabody Museum, Yale Univ., New Haven, Conn.....1930
HERSHKOVITZ, PHILIP, Dept. of Mammalogy, University Museum, Ann Arbor, Mich.....1932
HERZOG, DR. DIETRICH, Elisabethstrasse 3, Muenchen 13, Germany.....1931
HESEN, WILLIAM, U. S. Forest Service, Rutland, Vt.....1938
HESSE, CURTIS JULIAN, Box 288, F. E., College Station, Tex.....1940
HIBBARD, CLAUDE W., Museum of Paleontology, Univ. of Kansas, Lawrence, Kan..1932
HICKIE, PAUL F., Dimondale, Mich.....1931
HICKS, DR. LAWRENCE E., Cooperative Wildlife Research Sta., Ohio State Univ., Columbus, Ohio.....1936
HILL, DR. JOHN ERIC, Dept. of Mammalogy, Amer. Museum Nat. Hist., New York City, N. Y.....1930
HINER, LAWRENCE E., 1231 Raymond St., St. Paul, Minn.....1937
HINSHAW, THOMAS DOANE, Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1936
HINTON, MARTIN A. C., British Museum of Natural History, London, S. W. 7, England.....1930
HITCHCOCK, HAROLD B., Univ. of Western Ontario, London, Ontario.....1940
HOCHBAUM, HANS ALBERT, 2002 Madison Ave., Madison, Wis.....1935
HODGES, CHARLES H., JR., 59 Kenwood Rd., Grosse Pointe Farms, Mich.....1927
*HODGES, WETMORE, Beverly Farms, Mass.....1927
HOFFMEISTER, DONALD F., Museum of Vertebrate Zoology, Berkeley, Calif.....1938
HOLDEN, GUERDON S., 8907 Lake Shore Blvd., Cleveland, Ohio.....1937

HOLDENRIED, ROBERT, Glenn, Calif.....1940
HOLLISTER, MRS. MABEL P., 1819 Ontario Place, N. W., Washington, D. C.....1925
HOLMAN, JOHN P., Fairfield, Connecticut.....1921
HOLT, ERNEST G., 2020 New York Ave., Washington, D. C.....Charter
HOOPER, DR. EMMET T., Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1934
HOPWOOD, DR. A. T., Dept. of Geology, British Museum (Natural History), London, S. W. 7, England.....1930
HORN, EVERETT E., 332 Giannini Hall, Berkeley, Calif.....1938
HORRING, H., Zoologisk Museum, Copenhagen, Denmark.....1924
HORSFALL, R. BRUCE, 3835 S. St., N. W., Washington, D. C.....Charter
HOSLETT, SHERMAN A., Luther College, Decorah, Ia.....1932
HOSLEY, NEIL W., Univ. of Connecticut, Storrs, Conn.....1933
HOSTETTER, DR. D. RALPH, Eastern Mennonite School, Harrisburg, Va.....1939
HOUSE, E. J., 57 Fidelity Bldg., Pittsburgh, Pa.....1926
HOVEY, ALBERT B., 50 Park Ave., Wakefield, Mass.....1938
HOWARD, JOHN K., 55 Congress St., Boston, Mass.....1928
HOWARD, WILLIAM JOHNSTON, R. F. D. 3, Vienna, Va.....1935
*HOWELL, PROF. A. BRAZIER, Dept. of Anatomy, Johns Hopkins Medical School, Baltimore, Md.....Charter
HOWELL, DR. JOSEPH C., Dept. of Zoology, Oklahoma A. & M., Stillwater, Okla.....1940
HOY, DR. WILLIAM E., JR., Dept. of Biology, Univ. of South Carolina, Columbia, S. C.....1922
HUBBACK, THEODORE R., Sunlaws, Bukit Betong, Kuala Lipis, Pahang, Federated Malay States.....1922
HUBER, WHARTON, Academy of Natural Sciences, Philadelphia, Pa.....1922
HUESTIS, R. R., Dept. of Zoology, Univ. of Oregon, Eugene, Oreg.....1927
HUEY, LAURENCE M., Museum of Natural History, Balboa Park, San Diego, Calif.....Charter
HUGHES, GWLADYS F., St. James Apts., N. Charles & Center Sts., Baltimore, Md.....1937
HUNGATE, PROF. J. W., State Normal School, Cheney, Wash.....1925
HUTCHINSON, ARTHUR E., 184 S. Main St., Cedar City, Utah.....1940
INGLES, DR. LLOYD G., Chico State College, Chico, Calif.....1939
INGRAM, WILLIAM M., Dept of Zoology, Cornell Univ., Ithaca, N. Y.....1940
INKLEY, SCOTT R., Grays 24, Harvard Univ., Cambridge, Mass.....1936
JACKSON, ALFRED SLOAN, Box 1091, Throckmorton, Tex.....1939
JACKSON, PROF. C. F., Dept. of Zoology, Univ. of New Hampshire, Durham, N. H.....1921
*JACKSON, DR. HARTLEY H. T., Fish and Wildlife Service, Dept. Interior, Washington, D. C.....Charter
JACKSON, HERBERT W., Virginia Polytechnic Institute, Blacksburg, Va.....1936
JAEGER, EDMUND C., Dept. of Zoology, Junior College, Riverside, Calif.....1940
JEFFERS, EDMUND EVERETT, Box 265, Hastings, Mich.....1937
JEFFERS, DR. KATHARINE R., Dept. of Zoology, Women's College, Duke Univ., Durham, N. C.....1936
JELLISON, WILLIAM L., Hamilton, Mont.....1931
JENKINS, HUBERT OLIVER, 2116 3rd Ave., Sacramento, Calif.....1936
JENKINS, JAMES H., Ohio Cooperative Wildlife Research Unit, Ohio State Univ., Columbus, Ohio.....1940
JENKS, RANDOLPH, Rancho Esperero, University Sta., Tucson, Ariz.....1932

JENNER, WILLIAM ALEXANDER, 806 W. Davis St., Fayette, Mo.....1940
JEPSON, GLENN L., Dept. of Geology, Princeton Univ., Princeton, N. J.....1930
JESSEMAN, WINSTON, Bettsville, Seneca County, Ohio.....1940
JEWETT, STANLEY G., 1404 Bidwell St., S. E., Portland, Oreg.....Charter
JOHNSON, DAVID H., Museum of Vertebrate Zoology, Berkeley, Calif.....1933
JOHNSON, FRANK W., % Lago Petroleum Corporation, Apartado 172, Maracaibo, Venezuela.....1932
JOHNSON, JULIUS MONROE, 293 S. Pleasant Ave., Ridgewood, N. J.....1924
JOHNSON, MAYNARD S., New Holland, N. C.....1923
JOHNSON, DR. MURRAY L., Union Memorial Hospital, Baltimore, Md.....1936
JOHNSON, DR. PAUL BOWEN, 1673 Columbia Road, Washington, D. C.....1924
JOHNSTON, CLAUDE STUART, West Texas State Teachers College, Canyon, Tex.....1938
JONES, GORDON WILLIS, "Elwood," Wilderness, Va.....1934
JONES, H. WALTER, JR., 227 Haverford Ave., Swarthmore, Pa.....1937
JONES, PAUL V., 3415 Knight St., Dallas, Tex.....1939
JONES, S. PAUL, 509 West Ave., Waukesha, Wis.....1929
JOPSON, DR. HARRY, Bridgewater College, Bridgewater, Va.....1938
KALMBACH, E. R., Fish and Wildlife Service, Dept. of Interior, 562 Custom House, Denver, Colo.....1925
KALTER, LOUIS B., 535 Belmont Park N., Dayton, Ohio.....1935
KASHKAROV, DR. DANIEL N., Dept. of Ecology and Biology, Univ. of Leningrad, 7/9 Kv. 13, U. S. S. R.....1930
KATZ, DAVID, Ohio Wildlife Research Sta., Ohio State Univ., Columbus, Ohio.....1940
KEAYS, J. E., 328 St. George St., London, Ontario.....1924
KELKER, GEORGE HILLS, School of Forestry, Utah State Agricultural College, Logan, Utah.....1932
KELLOGG, JOHN P., Quadrangle Club, 1155 E. 57th St., Chicago, Ill.....1934
KELLOGG, DR. REMINGTON, Division of Mammals, U. S. National Museum, Washington, D. C.....Charter
KELLOGG, WILLIAM HUDSON, Game, Fish and Oyster Commission, Austin, Tex.....1939
KENDEIGH, DR. SAMUEL CHARLES, 204 Vivarium Bldg., Wright & Healey Sts., Champaign, Ill.....1937
KENWORTHY, WALTER J., 424 Knorr St., Philadelphia, Pa.....1940
KEZER, JAMES, 8 Glen Oaks Ave., Summit, N. J.....1938
KING, DR. HELEN D., Wistar Institute of Anatomy, 36th & Woodland Ave., Philadelphia, Pa.....1930
KING, JOHN ARTHUR, 5575 Bishop Road, Detroit, Mich.....1930
*KIRKHAM, PROF. WILLIAM B., 220 State St., Springfield, Mass.....Charter
KIRKWOOD, FRANK C., Baldwin, Baltimore County, Md.....Charter
*KIRN, ALBERT JOSEPH BERNARD, Box 157, Somerset, Texas.....1922
KLINGENBERG, PAUL J., Box 434, Farmington, N. M.....1938
KOBES, KARL G., Fish and Wildlife Service, Dept. of Interior, Holt, Minn.....1937
KOESTNER, E. J., 203 Vivarium Bldg., Univ. of Illinois, Champaign, Ill.....1940
KOFORD, CARL B., 1517 Euclid Ave., Berkeley, Calif.....1938
KOLB, CHARLES HAVEN, JR., 5210 Catalpa Rd., Baltimore, Md.....1938
KOLBE, FREDERICK F., Zoological Survey, Division of Veterinary Service, Onderstepoort, South Africa.....1939
KOMAREK, E. V., Sherwood Plantation, Thomasville, Ga.....1928
KOMAREK, ROY VANCE, Florida Game and Fresh Water Fish Commission, Tallahassee, Fla.....1935
KREFTING, LAURITS W., 4851 N. Mississippi Drive, Minneapolis, Minn.....1937

KUMMERLOWE, DR., Museum fur Tierkunde, Dresden 1, Germany....1930
KÜPFER, DR. MAX, Wissenschaftliches Laboratorium, Herdernstrasse 63, Zurich, Switzerland....1938
KURODA, MARQUIS NAGAMICHI, Fukuyoshi Cho, Akasaka, Tokyo, Japan....Charter
*LADD, DR. WILLIAM SARGENT, 135 E. 65th St., New York City, N. Y....1922
LAGLER, KARL F., Dept. of Zoology, Univ. of Michigan, Ann Arbor, Mich....1936
LANDBERG, ROBERT L., Colorado Museum of Natural History, City Park, Denver, Colo....1927
LANDWER, M. FREDERIC, Biology Dept., Texas Technological College, Lubbock, Tex....1933
LANE, DR. H. H., Dept. of Zoology, Univ. of Kansas, Lawrence, Kan....Charter
LANEY, LOUIS H., 402 Federal Bldg., Albuquerque, N. M....1939
*LANG, HERBERT, Transvaal Museum, Pretoria, South Africa....Charter
LANGENBACH, JOHN R., 2661 N. 6th St., Harrisburg, Pa....1938
LANGSTROTH, JAMES H., Silver City, N. M....1926
LANGWORTHY, DR. O. R., Johns Hopkins Hospital, Baltimore, Md....1928
LARRISON, EARL J., 1420 N. 48th St., Seattle, Wash....1940
LAY, DAN W., Box 1056, Lufkin, Tex....1938
LEAVENWORTH, MRS. ELLIS W., 320 E. 72nd St., New York City, N. Y....1935
LEBRECHT, ROBERT JAY, Ohio Wildlife Research Sta., Ohio State Univ., Columbus, Ohio....1939
LEE, ROBERT E., U. S. Soil Conservation Service, Shenandoah, Iowa....1937
LEE, ROBERT E., 2118 Polk St., Alexandria, La....1940
LEEDY, DANIEL L., Ohio Wildlife Research Unit, Ohio State Univ., Columbus, Ohio....1939
LEHMANN, VALGENE W., Box 163, Victoria, Tex....1938
*LEIGHTON, DR. ALEXANDER H., Johns Hopkins Hospital, Baltimore, Md....1924
LEISTER, DR. C. W., New York Zoological Park, 185th St. & Southern Blvd., New York City....Charter
LEOPOLD, DR. ALDO, 424 University Farm Place, Univ. of Wisconsin, Madison, Wis....Charter
LERAAS, DR. HAROLD J., Pacific Lutheran College, Parkland, Wash....1932
LESER, FELIX A., Saranac Lake, N. Y....1938
LEWIS, COL. GEORGE CHASE, 1240 Park Ave., New York City, N. Y....1939
LEWIS, JOHN B., Seward Forest, Triplett, Va....1926
LEWIS, DR. NOLAN D. C., New York State Psychiatric Institute, 722 W. 168th St., New York City, N. Y....1927
LICKING, CLYDE, P. O. Box 149, Omaha, Nebr....1931
LINCOLN, ALEXANDER, JR., 59 Codman Rd., Brookline, Mass....1935
LINSDALE, DR. JEAN, Jamesburg Route, Monterey, Calif....1921
LITTLE, DR. CLARENCE C., Bar Harbor, Maine....1927
LITTLE, LUTHER, 2305 Brentford Rd., San Marino, Calif....Charter
LLOYD, HOYES, 582 Mariposa Ave., Rockcliffe Park, Ottawa, Ontario....Charter
LONG, KINNEY EVERETT, Lucasville, Ohio....1940
LONG, WILBUR STUART, U. S. Soil Conservation Service, Salt Lake City, Utah....1936
LONGHURST, WILLIAM M., Box 5500, Sonoma Highway, Napa, Calif....1940
LÖNNBERG, DR. EINAR, Naturhistoriska Riksmuseum, Stockholm, 50, Sweden..Charter
LORING, JOHN ALDEN, Owego, Tioga County, N. Y....Charter
LOVELL, PROF. HARVEY BULFINCH, Belknap Campus, Univ. of Louisville, Louisville, Ky....1934
LOWERY, GEORGE H., JR., Louisiana State Univ., University, La....1936

LUDEMAN, BERNARD E., Box 254 F. E., College Station, Tex.....1940
LUTTRINGER, LEO A., JR., Board of Game Commissioners, Harrisburg, Pa.....1932
LYMAN, RUFUS ASHLEY, JR., 4507 Springdale Ave., Baltimore, Md.....1940
*LYMAN, PROF. THEODORE, Jefferson Physical Lab., Harvard Univ., Cambridge, Mass.....1921
*LYON, DR. MARCUS WARD, JR., 122 N. Lafayette Blvd., South Bend, Ind.....Charter
MACLULICH, DR. DUNCAN A., 144 Mavety St., Toronto, Ontario.....1933
MACNAB, PROF. JAMES A., Dept. of Zoology, University of Nebraska, Lincoln, Nebr.....1940
MACNAMARA, CHARLES, Arnprior, Ontario.....1927
MADISON, HAROLD L., Cleveland Museum of Natural History, 2717 Euclid Ave., Cleveland, Ohio.....Charter
*MANN, DR. WILLIAM M., National Zoological Park, Washington, D. C.....1926
MANVILLE, RICHARD H., Huron Mountain, Mich.....1939
MANWEILER, JACK, Resettlement Admin., Baudette, Minn.....1937
MARCOTTE, PETR. M. L. L'ABBÉ LÉON, Séminaire St. Charles, Sherbrooke, Quebec.....1926
MARSH, ERNEST G., JR., Box 102, Victoria, Texas.....1940
MARSHALL, WILLIAM H., Box 1998, Boise, Idaho.....1936
MARTIN, DR. E. WHITNEY, Stanford Univ., Calif.....1939
MASLIN, THOMAS PAUL, JR., 1616 Oxford St., Berkeley, Calif.....1939
MATHER, DEANE W., 810 Dorr Ave., Rhinelander, Wis.....1930
MCBEATH, DONALD Y., Midland Game Refuge, Sanford, Mich.....1937
MCCABE, BRITTON CHARLES, Springfield College, Springfield, Mass.....1940
MCCABE, FRANCIS R., P. O. Box 943, Eugene, Oreg.....1937
MCCLAIN, ANDREW W., Route 1, Box 72, Clovis, Calif.....1937
MCCULLOUGH, GEORGE W., 4858 Lyndale Ave., Minneapolis, Minn.....1937
MCGREGOR, PROF. JAMES H., Columbia Univ., New York City, N. Y.....1927
MCILHENNY, EDWARD A., Avery Island, La.....Charter
MCLAIN, ROBERT B., P. O. Box 132, Hollywood Sta., Los Angeles, Calif.....Charter
MCLEAN, DONALD D., 101 E. Saint James St., San Jose, Calif.....1938
MCMILLAN, THOMAS, 404 Clermont Ave., Dallas, Texas.....1938
MCMURRY, FRANK B., Wichita Mountains Wildlife Refuge, Cache, Okla.....1936
MELKONIAN, E., 510 22nd Ave., San Francisco, Calif.....1938
MELLON, RICHARD K., Mellon National Bank, Pittsburgh, Pa.....1940
MENDALL, HOWARD L., 9 Coburn Hall, Univ. of Maine, Orono, Maine.....1940
MERRILL, HOWARD ALDEN, Storrs, Conn.....1938
MESSER, HAROLD M., 300 Pearl St., Brooklyn, N. Y.....1926
METCALF, PROF. Z. P., North Carolina State College, Raleigh, N. C.....Charter
MEYER, GARDINER HOWLAND, Shore Acres, Bayside, N. Y.....1939
MIDDLETON, DR. AUSTIN R., Biological Laboratories, Univ. of Louisville, Louisville, Ky.....1921
MILLER, DR. ALDEN H., Museum of Vertebrate Zoology, Berkeley, Calif.....1930
MILLER, FREDERIC W., 5707 Marquita St., Dallas, Tex.....1921
MILLER, GERRIT S., JR., U. S. National Museum, Washington, D. C.....Charter
MILLER, DR. LOYE H., Univ. of California, Los Angeles, Calif.....Charter
MILLER, RICHARD G., Denison, Iowa.....1936
MILLER, ROBERT C., California Academy of Sciences, San Francisco, Calif.....1938
MILLER, PROF. SHIRLEY P., Institute of Anatomy, Univ. of Minnesota, Minneapolis, Minn.....Charter

MIRGUET, JOSEPH C., 104 Platt St., Rochester, N. Y.....1928
MITCHELL, KENNETH A., Box 58, McArthur, Ohio.....1940
MOFFITT, JAMES, 1879 Broadway, San Francisco, Calif.....1929
MOHR, CARL OTTO, Illinois Natural History Survey, Urbana, Ill.....1927
MOHR, CHARLES EDWARD, 815 Greenwich St., Reading, Pa.....1932
MOHR, ERNA W., Zoologische Museum, Hamburg, Germany.....1928
MONSON, GALE, 1410 East Helen, Tucson, Ariz.....1935
MONSON, JERID, Richwood, Ohio.....1940
MONTGOMERY, ROBERT D., Division of Wildlife Research, Univ. of Maine, Orono, Maine.....1936
MOODY, DR. PAUL A., Dept. of Zoology, Williams Science Hall, Burlington, Vt.....1923
MOORE, A. W., 673 E. Main St., Hillsboro, Oreg.....1921
MOORE, ROBERT T., R. R. No. 1, Box 28A, Pasadena, Calif.....1926
MOORE, ROY, 1105 Masonic Temple, New Orleans, La.....1939
MOREE, RAY, Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich.....1936
MORI, TAMEZO, Preparatory Dept., Keijo Imperial Univ., Seoul, Korea.....1928
MORRISON-SCOTT, TERENCE C. S., British Museum (Natural History), Cromwell Rd., London, S W 7, England.....1938
MORRISSEY, THOMAS, 921 Mississippi Ave., Davenport, Iowa.....1939
MORSE, W. B., 435 N. 34th St., Corvallis, Oreg.....1939
MORTON, JAMES NEWTON, 210 Hummel Ave., Lemoyne, Pa.....1937
MOSBY, HENRY S., 922 Harrison St., Lynchburg, Va.....1937
MOSELEY, PROF. E. L., State Univ., Bowling Green, Ohio.....Charter
MOSSMAN, DR. HARLAND W., Science Hall, Univ. of Wisconsin, Madison, Wis.....1930
MOULTHROP, PHILIP, Cleveland Museum of Natural History, 2717 Euclid Ave., Cleveland, Ohio.....1936
MURDOCK, MRS. DONALD R., 13609 Mettetal Ave., Detroit, Mich.....1930
MURIE, DR. ADOLPH, Jackson, Wyoming.....1924
MURIE, OLAUS J., Jackson, Wyoming.....Charter
MURRAY, DR. JOSEPH M., Dept. of Zoology, Univ. of Maine, Orono, Maine.....1937
MURRAY, DR LEO T., Box 72, Baylor Univ. Sta., Waco, Tex.....1936
MUSGRAVE, DR. JOHN K., 350 Parkway Drive, Pittsburgh, 16, Pa.....1937
MYRLAND, A. L., Rancho Montoso, Magdalena, N. M.....1938
NECKER, WALTER L., 2001 N. Clark St., Chicago, Ill.....1936
NEIL, RICHARD W., 4173 Wilson Ave., San Diego, Calif.....1940
NELSON, ARNOLD L., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1932
NELSON, THEODORA, 2695 Heath Ave., New York City, N. Y.....1929
NETTING, M. GRAHAM, Carnegie Museum, Pittsburgh, Pa.....1934
NEUSTADTER, LOUIS W., 6845 Odin St., Hollywood, Calif.....1939
NEWSOM, WILLIAM M., 224 E. 61st St., New York City, N. Y.....1926
NICHOL, A. A., 901 N. Tyndall Ave., Tucson, Ariz.....1935
NICHOLS, DAVID GELSTON, 116 9th St., Garden City, N. Y.....1936
NICHOLS, JOHN TREADWELL, Amer. Museum Nat. Hist., New York City, N. Y.....Charter
NICHOLS, WALTER F., 120 S. San Rafael Ave., Pasadena, Calif.....1940
NICHOLSON, DR. ARNOLD JOSEPH, Game, Fish and Oyster Commission, Austin, Tex.....1936
NIVEN, DR. CHARLES D., Divenick Lodge, Quarrie, via. Ottawa, Ontario.....1939
NOBLE, DR. G. K., Amer. Museum Nat. Hist., New York City, N. Y.....1926
NORRIS, RUSSELL T., Cooperative Research Unit, Pennsylvania State College, State College, Pa.....1940

NORTH, CHANDLER P., 68 Tamalpais Rd., Berkeley, Calif.....1938
NORTON, ARTHUR H., Museum of Natural History, 22 Elm St., Portland, Maine.....Charter
O'CONNELL, HAROLD J., East Loop Rd., Dongan Hills, Staten Island, N. Y.....1939
O'DONOGHUE, PROF. CHARLES H., Dept. of Zoology, Univ. of Scotland, Edinburgh, Scotland.....Charter
OGNEV, DR. S. I., Ul. Granovskogo 4, KV. 6, Moscow, U. S. S. R.....1925
OKKELBERG, PROF. PETER, 1220 Fair Oaks, Ann Arbor, Mich.....Charter
OLSON, ANDREW C., JR., 4412 Campus Ave., San Diego, Calif.....1940
O'NEILL, TED, St. Bernard, La.....1939
ORANGE, JEANETTE, 19 E. 213th St., New York City.....1937
ORR, DR. ROBERT T., California Academy of Sciences, San Francisco, Calif.....1931
OSBORN, CHASE S., Homestead, Chippewa County, Mich.....1925
OSGOOD, FREDERICK L., JR., 17 Charles St., Rutland, Vt.....1933
*OSGOOD, DR. WILFRED H., Field Museum of Natural History, Chicago, Ill...Charter
OSMER, T. L. G., 3901 Upton Ave., S., Minneapolis, Minn.....1939
OSTENSON, BURTON T., Dept. of Zoology, Michigan State College, East Lansing, Mich.....1933
PACK, ARTHUR N., American Nature Association, 1214 16th St., Washington, D. C.....1929
PACKARD, FRED MALLERY, National Park Service, Estes Park, Colo.....1940
PALMER, DR. E. LAURENCE, Fernow Hall, Ithaca, N. Y.....1927
PALMER, L. J., Fish and Wildlife Service, Dept of Interior, Juneau, Alaska.....1927
PALMER, RALPH S., Lab. of Ornithology, Fernow Hall, Cornell Univ., Ithaca, N. Y.....1938
PALMER, DR. T. S., 1939 Biltmore St., Washington, D. C.....Charter
PARKER, DR. GEORGE H., 16 Berkeley St., Cambridge, Mass.....Charter
PARKER, HARRY C., Olympic National Park, Port Angeles, Wash.....1927
PARKER, WESLEY D., Sullys Hill National Preserve, Ft. Totten, N. D.....1926
PARKER, WILLIE C., Game, Fish and Oyster Commission, Austin, Tex.....1940
PARTCH, MAX L., 815 Prairie St., Columbus, Wis.....1938
PATTON, C. P., Box 212, Kinston, N. C.....1939
PAXTON, J. WALTER, Museum of Paletontology, Univ. of California, Berkeley, Calif.....1938
PEARCE, JOHN, Northeastern Forest Exper. Sta., New Haven, Conn.....1932
PEARL, DR. RAYMOND, 1901 E. Madison St., Baltimore, Md.....1938
PEARSON, DR. ALLEN M., Box 1031, Alabama Polytechnic Institute, Auburn, Ala.....1938
PEARSON, OLIVER P., 210 W. Mermaid Lane, Chestnut Hill, Philadelphia, Pa....1938
PETERS, JAMES L., Lane End, Harvard, Mass.....Charter
PETERSON, RANDOLPH L., Box 254 F. E., College Station, Tex.....1940
PETTINGILL, DR. OLIN SEWALL, JR., Dept. of Zoology, Carlton College, Northfield, Minn.....1936
PFLUEGER, AL, 1367 N. Miami Ave., Miami, Fla.....1939
PHILLIPS, FRANK, F. P. Ranch, Route 4, Bartlesville, Okla.....1926
PHILLIPS, JOHN M., 2227 Jane St., Pittsburgh, Pa.....Charter
PICKWELL, DR. GAYLE B., State Teachers College, San Jose, Calif.....1926
PINTO, HERMAN T., Box 297, State College, N. M.....1938
PISSAREWSKY, DR. J. Y., Head of Ringling Bros. Zoo farm, Sarasota, Fla.....1940
POHLE, DR. HERMANN, Zoologisches Museum, Invalidenstrasse 43, Berlin, N., 4 Germany.....1928

POOLE, EARL L., Reading Public Museum, Reading, Pa.....1922
*POPE, GUSTAVUS D., 1020 Ford Bldg., Detroit, Mich.....1924
PORRO, THOMAS JOSEPH, 718 Medical Arts Bldg., Tacoma, Wash.....1931
POURNELL, GEORGE H., Univ. of Florida, Gainesville, Fla.....1940
PREBLE, EDWARD A., 3027 Newark St., Washington, D. C.....Charter
PREBLE, NORMAN A., Cooperative Wildlife Research Sta., Ohio State Univ., Columbus, Ohio.....1936
PRESNALL, CLIFFORD C., 5315 Earlston Drive, Washington, D. C.....1936
PRINCE, LESLIE A., Royal Ontario Museum of Zoology, Toronto, Ontario.....1938
PROVOST, MAURICE W., 21 Bagdad Rd., Durham, N. H.....1939
RABB, JOSEPH CARROLL, Box 39, Elizabeth City, N. C.....1940
RACEY, KENNETH, 3262 W. First Ave., Vancouver, B. C.....1938
RAMSDELL, FRANCES, 1837 Vinewood Blvd., Ann Arbor, Mich.....1939
RAMSDEN, DR. CHARLES T., 8 y 19, Vista Alegre, Santiago de Cuba, Cuba...Charter
RAND, DR. A. L., Amer. Museum Nat. Hist., New York City, N. Y.....1933
RANDALL, PIERCE E., 1-A Horticulture Bldg., State College, Pa.....1940
RAPP, WILLIAM F., JR., 88 Washington Ave., Chatam, N. J.....1940
RASMUSSEN, DR. D. IRVIN, Fish and Wildlife Service, Dept. of Interior, Utah State Agricultural College, Logan, Utah.....1936
RAVEN, HARRY C., Amer. Museum Nat. Hist., New York City, N. Y.....Charter
RAYNES, GEORGE W., 209 Miller Ave., Portsmouth, N. H.....1926
REEVES, MARK W., Stockade, Clinton, Conn.....1929
REHN, JAMES A. G., Academy of Natural Sciences, Philadelphia, Pa.....Charter
RETT, EGMONT Z., Santa Barbara Museum of Natural History, Santa Barbara, Calif.....1937
RETTIG, RICHARD W., JR., 1723 Edgeley St., Philadelphia, Pa.....1940
RICHARDSON, WILLIAM B., Star Route 2, Box 321, Porterville, Calif.....1933
RICHEY, K. A., Museum of Paleontology, Univ. of California, Berkeley, Calif...1938
RICHTER, DR. CURT P., Psychological Lab., Johns Hopkins Hospital, Baltimore, Md.....1924
RIEMER, JULIUS, Berlinerstr 163, Berlin-Tempelhof, Germany.....1930
RILEY, J. H., U. S. National Museum, Washington, D. C.....Charter
*RINDSFOOS, WILLIAM, Brunson Bldg., Columbus, Ohio.....Charter
RITER, WILLIAM E., Fish and Wildlife Service, Dept. of Interior, Washington, D. C.....1940
RITTER, DR. WILLIAM E., Dept. of Zoology, Univ. of California, Berkeley, Calif.....1926
ROBERTS, AUSTIN, Transvaal Museum, Pretoria, South Africa.....Charter
ROBERTS, HOWARD RADCLYFFE, Villa Nova, Pa.....1925
ROBERTS, DR. THOMAS S., Zoological Museum, Univ. of Minnesota, Minneapolis, Minn.....Charter
ROBERTSON, HOWARD, 157 Wilton Drive, Los Angeles, Calif.....Charter
ROBINSON, JAMES BURNHAM, 217 Seward Place, Schenectady, N. Y.....1923
RODE, DR. PAUL, Museum d'Historie Naturelle, 55 Rue de Buffon, Paris, 5, France.....1938
RODECK, HUGO G., Museum Univ. of Colorado, Boulder, Colo.....1939
RODGERS, THOMAS L., Museum of Vertebrate Zoology, Univ. of California, Berkeley, Calif.....1938
ROGERS, ALBERT C., Colorado Museum of Natural History, Denver, Colo....Charter
*ROGERS, CHARLES H., Museum of Zoology, Princeton, N. J.....Charter
ROOSEVELT, KERMIT, % Kerr Line, 240 Battery St., San Francisco, Calif.....Charter

ROOSEVELT, THEODORE, JR., Oyster Bay, New York, N. Y.....1925
ROSS, ROLAND CASE, 1820 Bushnell Ave., South Pasadena, Calif.....1926
ROTH, ADOLPH R., % Strawberry Resort, Kyburz, Calif.....1938
ROUSE, CHARLES H., Wichita Mountains Wildlife Refuge, Cache, Okla.....1938
ROWAN, PROF. WILLIAM, Univ. of Alberta, Edmonton, Alberta.....1921
ROWLEY, JOHN STUART, 424 N. Valencia, Alhambra, Calif.....1928
RUDD, R. L., 345 West St., Salinas, Calif.....1938
RUHE, DR. HERMANN, Kalandstrasse, Alfeld (Leine), Germany.....1930
RUHL, H. D., Dept. of Conservation, Lansing, Mich.....1929
RUSCONI, CARLOS, Garay 3818, Buenos Aires, Argentina.....1933
RUSH, W. M., 1527 N. E. Clackamas St., Portland, Oreg.....1925
RUSSELL, C. P., U. S. National Park Service, Dept. of Interior, Washington, D. C.....1931
RUSSELL, WARD C., Museum of Vertebrate Zoology, Univ. of California, Berkeley, Calif.....1930
RUST, HENRY J., Box 683, Coeur d'Alene, Idaho.....1922
SAGE, DEAN, JR., Llewellyn Park, Orange, N. J.....1933
SANBORN, COLIN C., Field Museum of Natural History, Chicago, Ill.....1930
SANDERS, EARL, Iowa State College, Dept. of Zoology and Entomology, Ames, Iowa.....1939
SANDERS, R. DALE, U. S. Forest Service, Park Falls, Wis.....1938
SANDERSON, WILFORD E., 135 Washington Ave., Albany, N. Y.....1927
SAUNDERS, W. E., 240 Central Ave., London, Ontario.....Charter
SAWYER, DR. ELIZABETH L., Converse College, Spartanburg, S. C.....1936
SAYLES, E. DUANE, Virginia Jr. College, Virginia, Minn.....1931
*SCALON, W. W., Traudowaja No. 6, Nowosibirsk, U. S. S. R.....1927
SCHAEFFER, BOBB, 4634 Spruce St., Philadelphia, Pa.....1936
SCHANTZ, MISS VIOLA S., Apt. 506, 1437 Rhode Island Ave., N. W., Washington, D. C.....Charter
SCHAUENSEE, RODOLPHE MEYER DE, Devon, Pa.....1931
SCHEFFER, THEOPHILUS H., Puyallup, Wash.....Charter
SCHEFFER, DR. VICTOR B., 105 Anderson Hall, Univ. of Washington, Seattle, Wash..1938
SCHERER, LLOYD E., JR., 216 Arnold Ave., Port Allegany, Pa.....1940
SCHEVILL, MRS. W. E., Museum of Comparative Zoology, Cambridge, Mass.....1933
SCHLAIKJER, DR. ERICH M., Dept. of Geology, Brooklyn College, Bedford Ave. and Ave. H, Brooklyn, N. Y.....1931
SCHMIDT, DR. KARL PATTERSON, Field Museum of Natural History, Chicago, Ill.....1925
SCHOONMAKER, WALTER J., State Museum, Albany, N. Y.....1925
SCHORGER, A. W., 168 N. Prospect Ave., Madison, Wis.....1924
SCHULTZ, DR. ADOLPH H., Dept. of Anatomy, Johns Hopkins Medical School, Baltimore, Md.....Charter
SCHULTZ, DR. C. BERTRAND, Nebraska State Museum, Univ. of Nebraska, Lincoln, Nebr.....1934
SCHWARZ, MAX D., 625 Tuxedo Blvd., Webster Groves, Mo.....1934
SCOTT, PROF. JOHN W., Dept. of Zoology, Univ. of Wyoming, Laramie, Wyo.....1925
SCOTT, THOMAS G., Dept. of Zoology and Entomology, Iowa State College, Ames, Iowa.....1937
SCOTT, WALTER E., Conservation Dept., Madison, Wis.....1937
SCOTT, WALTER J., Swarthmore College, Swarthmore, Pa.....1933
SEAMANS, ROGER, Fish and Game Service, Montpelier, Vt.....1938

SEFTON, JOSEPH W., JR., 638 F. St., San Diego, Calif.....1925
SELLE, RAYMOND M., Occidental College, Los Angeles, Calif.....1928
*SETON, ERNEST THOMPSON, Seton Village, Sante Fe, N. M.....Charter
SETON, HENRY, Museum of Comparative Zoology, Cambridge, Mass.....1924
SEVERAID, JOYE H., Div. Wildlife Research, Univ. of Maine, Orono, Maine.....1940
SHADLE, PROF. ALBERT R., Univ. of Buffalo, Buffalo, N. Y.....1925
SHAMEL, H. HAROLD, U. S. National Museum, Washington, D. C.....1923
SHARP, HENRY E., 179 Pine St., Holyoke, Mass.....1940
SHARP, DR. WARD M., Valentine Lakes Refuge, Valentine, Nebr.....1936
SHAW, CHARLES RICHARD, Route 3, Baton Rouge, La.....1939
SHAW, DR. WILLIAM T., 1002 Cambridge Ave., Fresno, Calif.....Charter
SHEARER, DR. AMON R., Mont Belvieu, Tex.....1923
SHELDON, WILLIAM GULLIVER, R.F.D. 1, Woodstock, Vt.....1933
SHELFORD, DR. VICTOR E., Vivarium Bldg., Wright & Healey Sts., Champaign, Ill.....1923
SHEPPARD, WALTER B., 1060 Gaylord St., Denver, Colo.....1929
*SHERMAN, MISS ALTHEA R., National, via McGregor, Iowa.....Charter
SHERMAN, DR. HARLEY B., R.F.D. 2, Gainesville, Fla.....Charter
*SHIRAS, HON. GEORGE, 3d, 460 E. Ridge St., Marquette, Mich.....Charter
SIEGLER, HILBERT R., Box 1056, Lufkin, Tex.....1937
*SILLIMAN, O. P., Cor. Alisal & Riker Sts., Salinas, Calif.....1924
SILVER, JAMES, Fish and Wildlife Service, Dept. of Interior, 1013 Glenn Bldg., Atlanta, Ga.....Charter
SIME, PALMER, 1519-25th St., Lubbock, Tex.....1937
SIMPSON, DR. GEORGE GAYLORD, Amer. Museum Nat. Hist., New York City, N. Y.....1928
SIMPSON, JAMES ELLIOTT, Museum of Vertebrate Zoology, Univ. of California, Berkeley, Calif.....1938
SKILLEN, DR. DONALD R., Route 1, Box 65, Pasadena, Calif.....1933
SMEAD, JULIA, 1251 S. Downing St., Denver, Colo.....1938
SMILEY, ALBERT K., JR., Mohonk Lake, N. Y.....1931
SMILEY, DANIEL, JR., Mohonk Lake, N. Y.....1933
SMITH, CLARENCE F., Fish and Wildlife Service, % Experiment Station, Mt. Shasta, Calif.....1936
SMITH, HORACE G., 2918 Lafayette St., Denver, Colo.....Charter
SMITH, LAURENCE H., Box 474, McMinnville, Oreg.....1936
SMITH, LLOYD MASON, 2613 Hillegass, Berkeley, Calif.....1938
SMITH, MISS NATASHA D., 2203 Piedmont Ave., Berkeley, Calif.....1940
SMITH, RONALD WARD, Dept. of Biology, Queens Univ., Kingston, Ontario.....1939
SMITH, WENDELL P., Wells River, Vt.....1927
SNYDER, L. L., Royal Ontario Museum of Zoology, Toronto, Ontario.....1921
SOLLBERGER, DWIGHT E., Indiana State Teachers College, Indiana, Pa.....1938
SOOTER, CLARENCE A., Malheur Migratory Bird Refuge, Burns, Oreg.....1938
SOPER, J. DEWEY, 827 Riverwood Ave., Winnipeg, Manitoba.....Charter
SOWERBY, ARTHUR DEC., 34 Lucerne Rd., Shanghai, China.....Charter
SPALDING, EDWARD LEWIS, 37 Bromfield St., Newburyport, Mass.....1937
SPALDING, IRWIN, P. O., Box 2787, Honolulu, Hawaii.....1928
SPAULDING, PROF. M. H., 122 N. Bozeman, Bozeman, Mont.....Charter
SPENCER, DONALD A., R. D. 3, Poughkeepsie, N. Y.....1928
SPERRY, PROF. ARTHUR BRADLEY, Kansas Agricultural College, Manhattan, Kan.....1923

SPERRY, CHARLES C., 1455 S. Franklin St., Denver, Colo.....Charter
SPRAGUE, JAMES M., Dept. of Zoology, Univ. of Kansas, Lawrence, Kan.....1937
SPRINGER, STEWART, Bass Biological Lab., Englewood, Fla.....1936
SPRINKLE, CHARLES ROGER, Hill, Mont.....1937
STAFFORD, RALPH L., Pasadena, Tex.....1940
STAGER, KENNETH, 4300 Budlong Ave., Los Angeles, Calif.....1936
STANFORD, J. S., Utah State Agricultural College, Logan, Utah.....1931
STEBLER, ADOLPH M., Cusino Wildlife Exper. Sta., Shingleton, Mich.....1934
STEENBERG, DR. CARL M., Silene Alle 9, Copenhagen-Soeborg, Denmark.....1930
STEGEMAN, DR. LEROY C., New York State College of Forestry, Syracuse, N. Y..1929
STEINER, L. D., 802 Whangpoo Road, Far Rockaway, N. Y.....1939
STEPHAN, JOSEPH A., 34 Louis St., Cincinnati, Ohio.....1935
STEVENSON, JAMES O., Aransas Waterfowl Refuge, Austwell, Tex.....1939
STEWART, PAUL A., Leetonia, Ohio.....1940
STEWART, PHILIP B., 1228 Wood Ave., Colorado Springs, Colo.....1921
STILES, DR. C. W., Room 302, U. S. National Museum, Washington, D. C.....1929
STIRTON, DR. R. A., Museum of Paleontology, Berkeley, Calif.....1923
STOCK, DR. CHESTER, California Institute of Technology, Pasadena, Calif.....Charter
STODDARD, HERBERT L., The Hall, Rt. 1, Tallahassee, Fla.....Charter
STONE, HARRY H., Box 101, Sturbridge, Mass.....1926
STONE, NED, 2418 California St., Berkeley, Calif.....1940
STONER, DR. DAYTON, New York State Museum, Albany, N. Y.....Charter
STORER, ROBERT WINTHROP, 522 Vose Ave., South Orange, N. J.....1937
STORER, DR. TRACY I., Division of Zoology, Univ. of California, Davis, Calif..Charter
STOUT, THOMPSON M., Morrill Hall, Nebraska State Museum, Lincoln, Nebr.....1935
STRAUS, DR. WILLIAM L., JR., Dept. of Anatomy, Johns Hopkins Medical School, Baltimore, Md.....1925
STRAY, JOSEPH W., 134–136 Broadway, Brooklyn, N. Y.....1924
STREATOR, CLARK P., 229 Otis St., Santa Cruz, Calif.....Charter
STUDHOLME, ALLAN T., Pennsylvania Wildlife Research Unit, 1-A Horticulture Bldg., State College, Pa.....1940
STUEWER, FREDERICK, Swan Creek Exper. Sta., Allegan, Mich.....1939
STUPKA, ARTHUR, National Park Service, Great Smoky Mountains National Park, Gatlinburg, Tenn.....1935
STURGIS, ROBERT S., 81 High St., Winnetka, Ill.....1939
STURTEVANT, MISS MARY, Zoology Dept., Univ. of Chicago, Chicago, Ill.....1940
SUMMERS, ROBT. H., Lakewood, Colo.....1940
SUMNER, E. L., JR., Box 188, Menlo Park, Calif.....1926
SUMNER, DR. FRANCIS B., Scripps Institution, La Jolla, Calif.....Charter
SVIHLA, DR. ARTHUR, Dept. of Zoology, Univ. of Washington, Seattle, Wash....1926
SWANSON, DR. GUSTAV, Div. of Economic Zoology, University Farm, St. Paul, Minn.....1935
SWENK, MYRON H., 1410 N. 37th St., Lincoln, Nebr.....Charter
SWINDLE, DR. PERCY F., 561 N. 15th St., Milwaukee, Wis.....1927
SWYNNERTON, Gerald H., Arusha, Tanganyika Territory, East Africa.....1940
SYKES, PROF. G. F., 416 Huntington Ave., Boston, Mass.....1935
TABER, F. WALLACE, Museum of Zoology, Univ. Michigan, Ann Arbor, Mich.....1939
TANNER, PROF. VASCO M., Brigham Young Univ., Provo, Utah.....Charter
TAPPE, DONALD T., Route 1, Box 450, Porterville, Calif.....1936
TATE, GEORGE H. H., Amer. Museum Nat. Hist., New York City, N. Y.....1924
TAYLOR, EDWARD HARRISON, Dept. of Zoology, Univ. of Kansas, Lawrence, Kan.....1924

TAYLOR, DR. WALTER P., Fish and Wildlife Service, Box 254 F. E., College Station, Tex. ..... Charter
TAYLOR, WILLIAM RALPH, Museum of Vertebrate Paleontology, Univ. of Kansas, Lawrence, Kan. 1939
TEACHENOR, DIX, Box 139, Kansas City, Mo. 1920
TERRES, J. KENNETH, 200 Pleasant St., Ithaca, N. Y. 1936
TEST, FREDERICK H., Dept. of Zoology, Univ. of Michigan, Ann Arbor, Mich. 1930
TEVIS, LLOYD P., Box 1416, Carmel, Calif. 1940
THONE, DR. FRANK, 2101 Constitution Ave., Washington, D. C. 1932
THORPE, DR. MALCOLM R., 10 Silver Sands Rd., East Haven, Conn. 1921
TIEMEIER, OTTO W., 301 Natural History Bldg., Univ. of Illinois, Urbana, Ill. 1938
TIHEN, JOE, Museum of Vertebrate Paleontology, Univ. of Kansas, Lawrence, Kan. 1940
TILLOTSON, DANIEL FIELD, 1398 Scenic Ave., Berkeley, Calif. 1937
TITUS, MISS WILHEMINA J., 14 Center St., Northport, Long Island, N. Y. 1940
TOMKINS, IVAN R., % U. S. Engineer Dept., Savannah, Ga. 1930
TOWNSEND, DR. CHARLES H., 340 E. 57th St., New York City, N. Y. 1930
TOWNSEND, PROF. M. T., Illinois Wesleyan Univ., Bloomington, Ill. 1928
TRAINER, JOHN E., State Teachers College, Johnson City, Tenn. 1938
TROST, HENRY J., DeYoung Memorial Museum, Golden Gate Park, San Francisco, Calif. 1926
TROWBRIDGE, ALBERT H., Fish and Wildlife Service, Santa Rita Range, Tucson, Ariz. 1937
TRYON, CLARENCE A., JR., Dept. of Zoology, Montana State College, Bozeman, Mont. 1940
TUBBS, FARLEY F., Game Div., Dept. of Conservation, Lansing, Mich. 1936
TWICHELL, ALLEN REED, Box 169, Union, Mo. 1939
TWINING, HOWARD, Museum of Vertebrate Zoology, Univ. of California, Berkeley, Calif. 1939
UHLER, FRANCIS M., Fish and Wildlife Service, Dept. of Interior, Washington, D. C. 1926
ULMER, FREDERICK A., JR., Academy of Natural Sciences, Philadelphia, Pa. 1939
VAN TYNE, DR. JOSSELYN, Museum of Zoology, Univ. of Michigan, Ann Arbor, Mich. 1924
VESTAL, ELDEN HALL, California Div. of Fish and Game, June Lake, Calif. 1936
VLADYKOV, V. D., 1577, rue Providence, Montreal, Quebec 1940
VOGHT, J. W., Lassen National Park, Mineral, Calif. 1939
VON BLOEKER, JACK C., JR., Los Angeles Museum, Exposition Park, Los Angeles, Calif. 1927
VORHIES, DR. CHARLES T., Univ. of Arizona, Tucson, Ariz. ..... Charter
VRTIS, DR. VLASTIMIL, Prazska 69, Brno, Czechoslovakia 1932
WACHTEL, IRWIN J., 619 Kent Ave., Brooklyn, N. Y. 1940
WADE, DOUGLAS EDWARD, Missouri Coop. Wildlife Research Unit, Columbia, Mo. 1940
WADE, DR. OTIS, Bessey Hall, State Univ., Lincoln, Nebr. 1926
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WRAY, WILLIAM, JR., Zoological Society, 34th & Girard Ave., Philadelphia, Pa.....1939
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WYLDE, HENRY ANSON, Los Angeles Museum, Exposition Park, Los Angeles, Calif..1931
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YERKES, DR. ROBERT M., 333 Cedar St., New Haven, Conn.....Charter

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ZIMMER, JOHN T., Amer. Museum Nat. Hist., New York City, N. Y.....Charter
ZIMMERMAN, FRED R., Wisconsin Conservation Dept., Madison, Wis.....1937

COMMENT AND NEWS

NOTICE OF ANNUAL MEETING

The twenty-third annual meeting of the American Society of Mammalogists will be held in Chicago, Illinois, during May or June, 1941. The exact date may be about May 15–20 or June 5–10. The Corresponding Secretary will be glad to receive comments from any members as to their preference between these dates and decision will be announced in the February number of the Journal. Dr. W. H. Osgood is chairman of the Local Committee on Arrangements.

Notice of the meeting, with further details as they become available, will appear in each forthcoming number of the JOURNAL, for the benefit of those who wish to plan ahead for attendance, and in the hope that a large number of members will be present.

Dr. Donald M. Hatfield, formerly instructor in economic zoology at the University of Minnesota, has been appointed curator of mammals in the museum of natural history of the Chicago Academy of Sciences.

MEMBERSHIP

Anyone interested in any phase of mammalogy is eligible for membership in the American Society of Mammalogists, and if elected will receive the Society's official publication, the Journal of Mammalogy, quarterly. Name and address, with remittance of $3.00 for annual dues, may be sent to the Corresponding Secretary, or to any officer of the Society. Membership is dated from the nearest January, although formal election will not take place until the annual meeting of the Society following the receipt of application.

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WILLIAM B. DAVIS, *Corresponding Secretary*
Department of Wild Game, Agricultural and Mechanical College of Texas,
College Station, Texas

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